With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CLII.—No. 3955] LONDON: FRIDAY EVENING, OCTOBER 30, 1931 [PRICE {WITH SUPPLEMENT} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

RAILS, &c.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 13th November, 1931, for the SUPPLY and ERECTION of RAILS and SLEEPERS at the National Physical Laboratory, Teddington.

Drawings, specification, a copy of the conditions and form of contract and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7723

Ministry of Transport.

APPLICATIONS are INVITED from qualified Mechanical and Automobile Engineers for a full-time non-pensionable APPOINTMENT as CERTIFYING OFFICER in the Southern Traffic Area, with headquarters at Reading, at a salary of £600 to £700 per annum inclusive, subject to a recent general deduction of 7½ per cent., with travelling, &c., expenses on the usual scale in respect of official journeys.

The duties of the appointment will be concerned with the issue of certificates of fitness of public service vehicles, and only professional mechanical and automobile engineers need apply.

Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, Whitehall-gardens, S.W. 1. Last day for receipt of applications 7th November, 1931. 7715

The Institution of Mechanical ENGINEERS.

THOMAS HAWKSLEY LECTURE, 1931.

Mr. LLEWELLYN B. ATKINSON will deliver the above LECTURE on "THE MECHANICAL ASPECTS OF ELECTRICITY" at the Institution, Storey's-gate, Westminster, on FRIDAY, 6th NOVEMBER, 1931, at 6 p.m. VISITORS ARE INVITED.

The Lecture will be repeated in Manchester on 19th November, in Glasgow on 10th December, and in Leeds on 11th February. 7719

NOTICE TO FOREMEN.

The National Foremen's Association is an Association of Foremen formed to represent them on all questions affecting their supervisory interests.

For full particulars apply, GENERAL SECRETARY, 95, Belgrave-road, Westminster, S.W. 1. 7608

Metropolitan Water Board.

TENDERS FOR THE MANUFACTURE, DELIVERY AND ERECTION OF ONE STEAM TURBINE WITH CENTRIFUGAL PUMPS AND ELECTRIC GENERATOR, TOGETHER WITH APPURTENANT WORKS, AT WALTON PUMPING STATION.

The Metropolitan Water Board invite TENDERS for the MANUFACTURE, DELIVERY and ERECTION of ONE STEAM TURBINE with CENTRIFUGAL PUMPS and ELECTRIC GENERATOR, &c., at their Walton Pumping Station, Hurst-road, West Molesey, Surrey.

Forms of Tender, conditions of contract, specification and drawing may be inspected without charge at the offices of the Board, Chief Engineer's Department (Room 173), on and after Friday, 23rd October, 1931.

Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of Two Guineas, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawing. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes addressed to the Clerk of the Board and endorsed "Tender for Pumping Machinery, Walton," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Tuesday, 24th November, 1931.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
19th October, 1931. 7704

Metropolitan Water Board.

TENDERS FOR THE MANUFACTURE, DELIVERY AND ERECTION OF THREE ELECTRICALLY DRIVEN VERTICAL CENTRIFUGAL WELL PUMPS AND ONE SET OF ELECTRICALLY DRIVEN HORIZONTAL TANDEM CENTRIFUGAL PUMPS, PIPING, &c., AT HAMPTON PUMPING STATION.

The Metropolitan Water Board invite TENDERS for the MANUFACTURE, DELIVERY and ERECTION of THREE ELECTRICALLY DRIVEN VERTICAL CENTRIFUGAL WELL PUMPS and ONE SET of ELECTRICALLY DRIVEN HORIZONTAL TANDEM CENTRIFUGAL PUMPS, PIPING, &c., at their Hampton Pumping Station, Upper Sunbury-road, Hampton, Middlesex.

Forms of Tender, conditions of contract, specification and drawing may be inspected without charge at the offices of the Board, Chief Engineer's Department (Room 173), on and after Wednesday, 28th October, 1931.

Contractors desirous of tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of Two Guineas, which must be deposited with the Accountant to the Board and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawing. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.

Tenders, enclosed in sealed envelopes addressed to the Clerk of the Board and endorsed "Tender for Centrifugal Pumps, &c., Hampton," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Tuesday, 24th November, 1931.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
19th October, 1931. 7705

The Engineer

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PUBLIC NOTICES.

Administrative County of LONDON.

The London County Council invites TENDERS for the SUPPLY, DELIVERY, ERECTION, and MAINTENANCE of THREE STEAM DISINFECTORS at London County Council Hospitals.

The specification, form of Tender, &c., in respect of each of the above works may be obtained on application to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by cheque, draft, or money order to the order of the London County Council.

This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 9th November, 1931, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGU H. COX,
7722 Clerk of the London County Council.

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PUBLIC NOTICES.

Borough of Acton.

FILTRATION PLANT.

The Town Council invites TENDERS for the INSTALLATION of FILTRATION PLANT at the Public Baths, Salisbury-street, Acton, W. 3.

Specification and form of Tender may be obtained and general conditions inspected upon application to Mr. W. G. Cross, Assoc. M. Inst. C.E., Borough Engineer, Municipal Offices, Acton, W. 3 on payment of a deposit of £3 3s., which will be refunded on receipt of a bona fide Tender and the return of all loaned documents.

Sealed Tenders, in the endorsed envelopes provided, must be delivered to the undersigned on or before 3 p.m., Monday, November 30th, 1931.

The Council does not bind itself to accept the lowest or any Tender received and canvassing in any form is prohibited.

JOHN MORGAN,
Town Clerk.

Municipal Offices,
Acton, W. 3. 7711

Borough of Stockton-on-Tees.

TO STEEL BUILDING CONSTRUCTORS.

OMNIBUS GARAGE.

The Omnibus Committee is prepared to receive TENDERS for the SUPPLY and ERECTION of STEEL WORK and ROOF in connection with a Structure in Boathouse-lane for Garage purposes. General plans and specification and form of Tender may be obtained upon application to Mr. J. F. Wakeford, M. Inst. C.E., Borough Engineer, Victoria Buildings, Stockton-on-Tees, on payment of a deposit of £2 2s., which will be refunded upon receipt of a bona fide Tender and the return of the necessary documents.

Tenders, endorsed "Omnibus Garage," must reach the undersigned not later than 10 a.m. on Monday, 9th November, 1931.

The lowest or any Tender will not necessarily be accepted.

THOS. DOWNEY,
Town Clerk.

Borough Hall, Stockton-on-Tees,
26th October, 1931. 7712

PUBLIC NOTICES.

Applications are Invited by an ELECTRICITY SUPPLY COMPANY, operating over a wide area, for a JUNIOR ASSISTANT to the ELECTRICAL ENGINEER. Must be well educated, Public School or University preferred.

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County Borough of Warrington

WATER DEPARTMENT.

APPOINTMENT OF ASSISTANT WATER ENGINEER.

The Corporation of Warrington invite APPLICATIONS from persons who have received training on the technical side of a Waterworks Department for the POSITION of ASSISTANT ENGINEER in their Water Department.

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Forms of application may be obtained from the undersigned, and are to be returned not later than the 16th November, 1931.

Canvassing will be regarded as a disqualification.

A. T. HALLAWAY,
Town Clerk.

Town Hall, Warrington,
23rd October, 1931. 7709

SITUATIONS OPEN.

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A Seven-Day Journal

The Wellington Harbour Floating Dock.

The large floating dock constructed by Swan, Hunter and Wigham Richardson, Ltd., under the general supervision of Messrs. Clark and Standfield, of Westminster, to the order of Mr. J. Marchbanks, M. Inst. C.E., general manager and chief engineer to the Wellington (New Zealand) Harbour Board, has now safely reached the roadstead of Tandjong Priok, at the port of Batavia, Java. The dock, which was towed out by two steam tugs belonging to the L. Smit and Co.'s International Towage Company, of Rotterdam, has now completed 13,500 miles, or nearly two-thirds of the distance from the Tyne to Wellington. So far, the voyage has been accomplished without mishap or hitch of any kind, and the progress made corresponds to an average speed of nearly 100 nautical miles per day. The route taken was *vid* the Suez Canal and the Malacca Strait. After the two tugs have been docked at Tandjong Priok the last part of the voyage will be begun, the dock passing through the Torres Strait, eastward of the Great Barrier Reef, and then south-east to Wellington. If all goes well, the longest tow on record should be completed and the dock reach its destination about Christmas Day. If this is accomplished, the dock, which left Wallsend-on-Tyne on July 15th last, will arrive about six weeks earlier than was originally estimated. The principal dimensions and particulars of the dock were given in our issue of June 5th last. If has a lifting power of 17,000 tons, with an overall length over platforms of 584ft., an overall width of 117ft., and a clear width between fenders of 88ft.

The Italian Liner Conte di Savoia.

On Wednesday last, October 28th, the 48,000-ton quadruple-screw Lloyd Sabaudo liner "Conte di Savoia" was safely launched from the San Marco shipyard of the Cantiere Reuniti dell'Adriatico, at Trieste. She marks a further step in the progress of Italian Transatlantic transport, and is noteworthy as being the first large passenger liner to be automatically stabilised on the Sperry gyroscopic system. Her principal dimensions are:—Overall length, 811ft. 9in.; breadth, moulded, 95ft. 10in.; average draught, 30ft. 6in.; approximate gross tonnage, 48,000. She will be propelled by four sets of Parsons turbines, which have been built at the firm's St. Andrea engine works. Steam is to be supplied by ten Yarrow boilers, with three high-pressure cylindrical boilers for auxiliary services. The form of the hull has been the subject of special research work at the Hamburg, Vienna, and Rome experimental tanks, and the design adopted will be one offering, it is anticipated, greatly reduced resistance. The design of the propellers is, also, receiving exceptional attention. The majority of the auxiliaries will be electrically driven. The capacity of auxiliary generator plant reaches about 5300 kW, and the equipment includes four turbo-generators, three oil engine driven generators, and oil-electric emergency generating sets. The mechanical parts of the stabilising equipment are being built by Vickers-Armstrongs at Barrow-in-Furness, while the electrical parts will be supplied by the Metropolitan-Vickers Company, of Trafford Park, the whole of the work being carried out under the supervision of the Sperry Gyroscope Company. The equipment will comprise three stabilisers, placed at the water line well forward. Each stabiliser has a 100-ton rotor, with a wheel diameter of 13ft. The keel of the "Conte di Savoia" was laid about a year ago, and her construction marks a record, both in time and in weight for the San Marco shipyard, at which several other large liners have already been built.

The Hudson River Bridge, New York.

On Saturday last, October 24th, the new George Washington Suspension Bridge over the Hudson River between Upper Manhattan and Fort Lee was formally opened by the Governors of New York and New Jersey. Over 5000 guests were invited by the Port of New York Authority to attend the opening ceremony, and some 25,000 persons watched it from the two ends of the bridge. The new bridge is the longest suspension bridge in the world, and its design and construction have been fully dealt with in our columns. The fourth progress report, signed by Mr. O. H. Ammann, Chief Engineer of Bridges to the Port of New York Authority, was summarised and illustrated in our issue of May 29th last, and the preceding reports in our issues of May 3rd, 1929, and August 1st, 1930. The length of the main span, it may be recalled, is 3500ft., while the roadway is 250ft. above the river, and is designed to clear the masts of the largest ocean-going vessels using the river. The supporting towers are 635ft. high, and in their construction about 40,000 tons of steel have been used. The suspending cables are four in number, arranged in two pairs, 106ft. apart, one pair being on each side of the bridge, the cables of each pair being arranged with their centres 9ft. apart. Each cable is 36in. in diameter, and contains 26,474 parallel steel wires, each 0·196in. in diameter. The wires are divided into sixty-one groups or strands of 434 wires each, and special spinning and compacting methods were employed. Over 28,370 tons of cable wire were used. The new bridge has a present designed capacity of 30,000,000 vehicles annually, and when the lower floor has been added to the present upper floor that capacity will be doubled. The completed bridge with the upper floor has cost 60 million dollars, and it is estimated that the lower floor will cost another 15 million dollars. On the experience gained with this bridge, two larger bridges are proposed, namely, the 4200ft. span bridge at Golden Gate, California, and the 4500ft. to 5000ft. span Narrows Bridge across New York Bay.

An American Shipping Merger.

For some time past it has been frequently stated that a great merger of American shipping interests was about to take place. The matter was recently fully discussed at a shipowners' conference in San Francisco, and it has now been announced by Mr. R. S. Dollar, vice-president of the Dollar Steamship lines, that the Dollar, Chapman and Dawson group on the Pacific Coast is to acquire half the ownership of the Roosevelt Steamship Company, which is itself interlocked with the International Mercantile Marine. The Dollar, Chapman and Dawson group and the Roosevelt Steamship Company are then to take over and own jointly through a holding company the United States Lines fleet, which will remain in Atlantic waters. The Dollar fleet activities will be concentrated on Pacific Coast, trans-Pacific and around-the-world services, while the Dawson companies will continue operation in the trans-Pacific and North Pacific-Europe trades, and there will be joint operation of the coastal services of the Panama-Pacific Dollar and Quaker lines. Counting forty foreign ships belonging to the Mercantile Marine Company with an aggregate gross tonnage of 333,585 and seventeen motorships from the American Pioneer Line, which is operated by the Roosevelt Steamship Company for the Shipping Board, the combination will control a fleet of 180 vessels, aggregating 1,376,350 gross tons. The Royal Mail and P. and O. are the only two groups controlling a greater tonnage. It is stated that one of the advantages of the merger is that it will assure the construction of two large liners to be added to the United States Line, with the object of placing that line on a parity with the other great passenger-carrying companies operating in the North Atlantic.

Railway Improvement Schemes.

Both the two northern railways, the L.N.E.R. and the L.M.S., announce considerable expenditure to be incurred within the next few months upon improvements. The former is to spend about £5,000,000, the works including the widening of the main lines at Shenfield, north of York, and at Inverkeilor, the construction of large sidings at Whitemoor, Doncaster, Hull and Mottram, and the extension of colour light signalling systems in many places. Fifteen locomotive depôts are to be remodelled, while special schemes for the construction of a large new fish dock at Grimsby, for the reconstruction of the fish market at Hull, and for the extension of Parkeston Quay, are also to be put in hand. Although the projected expenditure of the L.M.S. does not reach such a high figure as that of the L.N.E.R., about £2,000,000 will be spent by the company on improvements. The most costly undertaking is the electrification of the line between Barking and Upminster. New stations will be built at Southend, Westcliff and Leigh-on-Sea. The line is to be widened at Mirfield, a point on the line of communication between Lancashire and Yorkshire, while similar schemes will be carried out at a number of other points. About eighty bridges on that railway system are to be strengthened to enable them to carry locomotives of the heaviest type, while others are to be reconditioned. The G.W.R. has placed contracts for work for the Paddington and Cardiff rebuilding schemes to the value of £119,600. It is necessary to remind our readers that all these are not new schemes. Actually, all but one are over a year old; the exception is that at Shenfield on the London and North-Eastern, and it was ordered last July. The new railway in Mid-Notts. was in hand two years ago, and its progress was noted in our Annual Article on "Railways in 1929." The remaining ten schemes were begun during 1930 and reported upon in our Annual Article on January 16th last.

Man and the Hammer.

On Friday last the Autumn Session of the Institution of Mechanical Engineers was opened, as usual, by the delivery of the Presidential Address. Lieut.-Colonel Kitson Clark took for his subject "Humanity under the Hammer," and we have endeavoured, somewhat hopelessly, we fear, under the limitations prescribed by authority, to give, by means of extracts, some idea of the method and manner in which he treated the subject. He professed himself to be an antiquary, but he is first and foremost an engineer, is something of a poet, and knows how to blend a touch of gentle philosophy with romance. Added to these things there is an attribute which the written word barely shows—a sense of humour, even of pure fun, which is proper to the man himself, and cannot be adequately reflected in the Press. None knows better than Colonel Kitson Clark how to keep in happy touch with his audience—we would call it at-one-ment, if that marvellous word did not imply a measure of penitence—and to keep alive its sympathy. With these qualities, in the author and the text, the success of the address was a foregone conclusion. It was loudly acclaimed by a very large audience, which, in no uncertain way, showed its approval and endorsement of the graceful terms in which Mr. William Reavell expressed the thanks of the Institution for a discourse which he justly described as wonderful and romantic.

Agreement between the C.P.R. and C.N.R.

An agreement coming into operation at once and covering a period of ten years has been reached by the Canadian Pacific and Canadian National Railways. The two companies have agreed to co-operate in promoting rail and steamship business originating across the Atlantic or going through or from Canada to European ports. While the steamship company will, by the agreement, secure business originating on the Canadian National lines, the latter will gain the compensating advantage of the rail haul of freight, passenger and express business to and from the ships of the Canadian Pacific Company. In order to serve the Canadian National Railways, all Canadian Pacific passenger ships sailing to or from St. John, New Brunswick, will call at Halifax, Nova Scotia, both on westbound and eastbound voyages, while freight ships sailing from St. John eastwards will also call at that port. St. John will remain the Canadian National winter terminal port and will continue to handle through traffic as in the past. As a part of the agreement with the Canadian Pacific Steamships, the Canadian National representatives will become agents for the sale of passenger tickets and the through booking of freight. The agreement follows upon the policy of co-operation towards which the executives of the two companies have been working for some time past.

Losses in State Trading.

The shipping correspondent of *The Times* gave on Monday, October 26th, some interesting figures relating to the losses on State trading in so far as they refer to merchant shipping. These particulars form an effective reply to those who during the recent election urged that the basic industries of the country should be transferred from private ownership to public ownership and control. The figures for the United States up to the end of June, 1930, those for Canada to the end of 1930, and those for Australia up to April, 1928, when the sale of the Commonwealth Line took place, indicate the following losses:—United States, £670,000,000; Canada, £16,000,000; and Australia, £11,000,000. These debit balances do not tell the whole story. It is pointed out that indirect losses to all shipping are caused by competition on an unfair basis. Such indirect losses have in the past been particularly serious for Great Britain, in view of the extent to which she relies on her shipping services as one of the principal invisible exports. For last year the shipping earnings of our country were estimated at £100,000,000 compared with £130,000,000 in 1929. These values do not, of course, represent profit, as the greater part of the earnings is absorbed in maintaining the services, in the purchase of fuel and stores, and in paying wages. In normal times the profit might be not more than 5 per cent. of the earnings, which percentage has not probably been recently earned. Under ordinary trade conditions, however, the British shipping industry has contributed notably to help overseas trade, and has also assisted the national revenue through taxation. The results of Government-owned shipping ventures clearly go to show that if British shipping were to be transferred to public control, which is not likely under the new National Government, an enormous burden would be thrown on the Exchequer, to the great loss of the nation.

The Motor Car Show at Olympia.

The definite orders received as a result of the Motor Car Exhibition at Olympia, which closed on Saturday last, October 24th, form one of the most hopeful signs of a bright economic future, both for the motor trade itself and the many ancillary industries to which it is allied. The same, it is hoped and felt, will be true of the forthcoming Exhibition of commercial vehicles, which opens at Olympia on November 5th. In the case of the Motor Show, several firms, we understand, did extensive business with the Dominions and with all parts of Europe. One particular firm booked at the Exhibition more orders for export than its total of overseas sales during the last year. For Australia important developments included new arrangements for assembling British cars in Australia, and extended representation of different types of cars in the Commonwealth. The total attendance for the whole period was 186,773 persons, compared with 222,091 last year, while on the last Saturday 27,912 people paid for admission, against 34,922 on the last day of last year's Exhibition.

Press-Tool and Fixture Design.

By HENRY C. LANE.

No. XI.—JIGS AND FIXTURES (*continued*).*

SECTION II.—PIVOT PIECE ASSEMBLY JIG.

FIG. 77 shows the jig used for assembling the pivot pieces bent in the Figs. 13 and 14 tools to the clamped spring and base member described under Figs. 73 and 74. As explained in Part I., Section III., the blank is gauged for bending from the serrations, which

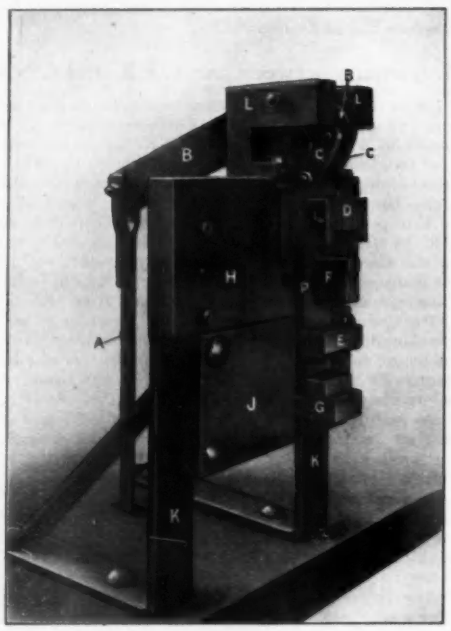


FIG. 77

are clearly visible in Fig. 79 at O′, on account of the fact that the ends of the blank, after bumping to a rough round section elongate to varied lengths, according to the variation of the hot rolled bar stock. For the same reason, it is not advisable to put in a definite additional bend, as at N′ in Fig. 79, which in the instance illustrated is just sufficient to allow the shortened pivot length to be placed in position between the perpendicular portions of the base member. Each piece therefore is bent to its individual requirements in the jig illustrated, and when the bending pressure is released there is sufficient spring

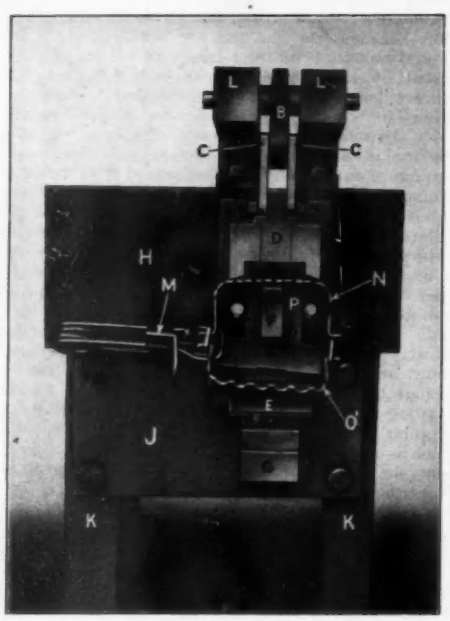


FIG. 78

in the metal of the pivot piece for the free end to enter its appropriate pivot hole in the base.

The jig in question was designed to take various sizes of parts and had to be capable of controlled bending of pivot pieces up to $\frac{5}{16}$in. in thickness. Obviously, a power-operated jig was out of the question, and, while the pressure required for bending was not very great, quite a respectable pressure was required for straightening out the bend after the pivot piece had been slipped into position. The jig was therefore designed to give a gradually increasing leverage, so that at the bottom of the stroke it would be possible to obtain and hold a steady pressure of 5 tons from foot power only. The whole jig is mounted on a bench on the brackets K, and is operated by a foot treadle—not shown—but connected to the working parts of the jig by the connecting-rod A, which rises as the treadle is depressed. The lettering on all four illustrations are the same as far as the jig itself is concerned. The assembled parts give a clearer idea of the spring clamp at M in Figs. 78 to 80 than shown in the previous section. In Fig. 78 the untouched pivot piece is shown at N, while the assembled piece can be seen at O′, and it will be noted that after having been straightened out, the pivot ends are brought to the original measurements when in position. In Fig. 79 the finished assembly of the one piece is again shown at O′, while at N′ is shown the other pivot bent just sufficiently to allow the free end to be brought into the correct alignment. In Fig. 80 both pivot pieces are assembled, that at O′ having been completely straightened, while that at O is in the process of being straightened out, the jig being practically at the bottom of its stroke.

Mounted on the brackets K are two wrought iron blocks H and J, while to the upper edge of the block H are mounted two overhanging bracket pieces L. These parts together form the framework of the jig. Pressure is taken from the foot treadle through the connecting bar on to the toggle lever B, the toggle action being completed by the links C. The lower ends of the toggle links are pivoted on the bending ram punch D, which is mounted on the slide P, which carries the moving pressure to the flattening ram punch E mounted on the lower extremity of the slide. The bending anvil F passes through a slot provided in the slide and is driven into the wrought iron block H. The flattening anvil G is driven into the block J. It will be noted that the bending ram punch is

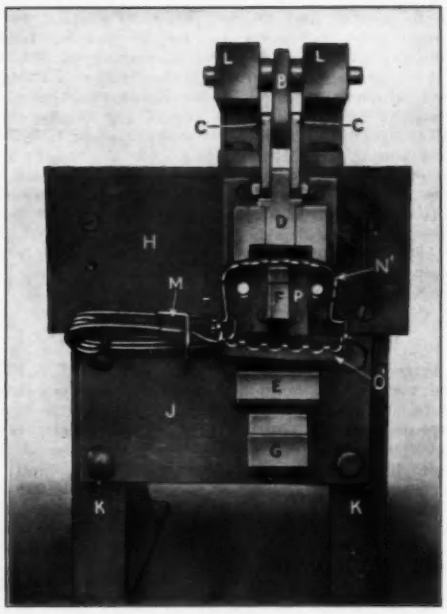


FIG. 79

composed of three parts, the centre part only being connected to the toggle links and ram slide, the outer bending points being screwed to the centre piece so that they can be replaced by pieces suitable for handling different thicknesses and sizes of pressings. The bending and flattening anvils are similarly replaceable for the same purposes of adjustment, and it is essential that so far as the flattening is concerned, the jig is adjusted in the anvil block itself so that the jig can be regularly brought to the bottom of the stroke when flattening is in progress, so that the maximum step-up in pressure is obtained from the toggle action. On the other hand, care must be taken to see that the anvil is not too slack with regard to the flattening ram, otherwise the bends put in in the upper stage will not be completely straightened out in the lower stage. The upper stage is adjusted so that the average pivot piece is sufficiently bent when the slide P is $\frac{1}{16}$in. from the bottom of its stroke. This allows for the variation in the length of the ends and, at the same time, renders each bend extremely easy of accurate control to the required dimensions. Without this control some pivot pieces might easily be bent to a point where they would not spring out sufficiently to enter both of the base member uprights, and this would add to the difficulty of the lower stage, as the ends would have to be guided into their pivot holes while the straightening was actually in progress. It will be noted that the bending points of the bending ram punch D are chamfered so that pressure is obtained and maintained as far as possible from the centre of the bend. This reduces the pressure required for bending and, therefore, increases the amount of control possible during the operation. The only other point to be noted with regard to the actual design is that the brackets L are extended down behind the block H for additional toggle strength.

In operation of the jig, the pairs of pivot pieces are always assembled in the order shown; that is to say, that the piece shown at O′ in Fig. 78 is completely assembled before that shown at N, and, with the exception of the placing of the pivot pieces facing opposite directions, the mode of procedure is identical.

The loose pivot piece is placed on the bending anvil, and the bending ram punch lowered sufficiently to grip the piece without actually bending. The upright in the base member passing through the spring eye is then threaded on to the one end of the pivot piece, resulting in the position shown in Fig. 78; pressure being applied and held results in the position shown in Fig. 79, when it is possible to bring the opposing pivot hole into register with the free end of the pivot piece, and by releasing the pressure the end of the pivot piece springs into the hole a short

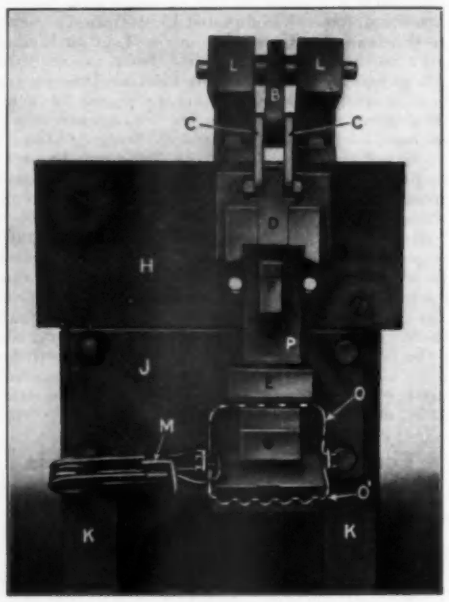


FIG. 80

distance sufficient to prevent it slipping out of place. The complete assembly is then finished, as shown in progress in Fig. 80, where the restraightening of the pivot piece is being carried out as described.

SECTION III.—LIGHT ROTARY HAMMER.

In connection with the pivot pieces referred to in the previous section, the small rotary hammer illustrated in Fig. 81 was designed to give two thousand featherweight blows per second.

In the illustration the blank of the pivot piece is shown at A, and the serrations in the one edge can be clearly seen. After bending, it is necessary to remove the sharp pressed edge from the surface of these serrations, and at one time this was done by

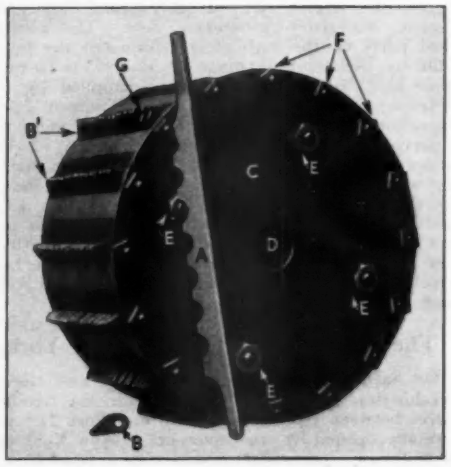


FIG. 81

filing. Later, filing was superseded by specially shaped rubber bonded grinding wheels, but, as various pivot pieces had different standard serrations, wheels had to be provided for each standard and, apart from the heavy cost in putting the correct shape on the edge of the wheel, a certain amount of skill was required in the operator to obtain the desired results. It was found that a light hammer blow could be made to give the desired results, and it only remained to design a hammer to give the required speed of blows, while adjusting itself to the serrations in the edge of the blank. The idea was tried out in simple stages, starting with a six-disc wheel, and from this it was found that it was necessary to have the minimum of weight in the small hammers and for the hammers to have a speed of between 600ft. and 650ft. per minute. The final shape of the small

* No. X. appeared October 23rd.

hammers is shown at B in Fig. 81, while the rows of hammers are shown at B′. In all, there are fifty-two discs, each of fifty of which carries eight of the small hammers. The complete wheel is mounted on an ordinary grinding spindle and run at 300 r.p.m., which produces 120 thousand separate blows on the blank per minute.

As soon as the final design of small hammer, disc and speed were decided upon, the complete hammer was made in the following manner. The fifty-two plates were temporarily clamped together and four holes drilled to accommodate the permanent clamping bolts E. These holes were drilled in a slightly uneven layout to guarantee correct assembly of the plates. After clamping with the bolts E, the spindle hole D was drilled and the complete block set up in a lathe and the outer edges of the discs trimmed up. Sixteen small holes were then drilled to house the hinge pins F for the small hammers which are mounted in rows of twenty-five. Two small pairs of press tools were then made to produce the small hammers, which were blanked from the same 16 s.w.g. spring steel from which the 8in. diameter discs were cut. A pair of notching tools were also made to notch the discs for the hammers to work in. The discs were then dismantled and numbered from 1 to 52, the first and last were removed and the remainder separated into odd and even numbers. A notch was taken from the same alternate holes in the outer edge of the one set of discs (eight notches per disc), and the other set of discs were notched in the intervening alternate holes. By this method the discs when assembled in correct order provided on their outer edges sixteen rows of twenty-five separate compartments for the small hammers, the notches in the one set of discs being covered by the unnotched edges of the adjoining discs, and the two end discs C completing the wheel. After pressing the small hammers, removing sharp edges from their working faces, hardening and tempering, they were assembled, one disc at a time, the discs being spaced by paper washers of a thickness to allow freedom of working to the small hammers. The actual power of the blows from these hammers is so slight that it is possible to put one's hand in the working area and experience no pain and very little discomfort beyond the intense vibration. On the other hand, the pressed edge of the blank in operation disappears like magic under the multiplicity of blows, and some idea of this can be gathered on noting the worn hammers at G, which have worn to this shape in under 200 gross operations. Renewal is very simple when a stock of prepared hammers is carried, and upkeep costs are considerably less than on grinding wheels, apart from the increased safety and freedom from dust. Again, as each disc of hammers is only separated by the thickness of the paper washers, a very slight lateral movement of the blank in operation is sufficient to cover the whole surface, the hammers accommodating themselves to the serrations automatically.

In operation one interesting point came to light with regard to the operators. Originally it was intended for the blank to be held in the hand, and for some time this was done. Employing female operators however, was apparently out of the question, since in practically every case they commenced to vomit after about ten minutes' work. Men and lads, on the other hand, were capable of carrying on indefinitely, even though lads of weak constitution were employed for a test. Eventually a carrier arm was designed, so that the bent blank could be dropped into a loose clamp and the whole brought into contact with the wheel by swinging up on the pivoted arm. The pivot for the arm was so placed that the shocks were taken directly on the carrier, and by leaving the operator thus free from excessive vibration or shock, it was found that female operatives could carry on indefinitely. Why such results as originally obtained from harmless blows should be, is more than I can say, but I pass on the information for what it is worth.

(To be continued.)

Humanity Under the Hammer.*

By Lieut.-Colonel E. KITSON CLARK, T.D., M.A.

I CLAIM it as true that mechanical history began with the hammer, and I have therefore dared to take as the title of the address that I present to your indulgent attention "Humanity under the Hammer." Cutting is dealt with in many papers in this hall, and more especially by our able Cutting Tools Research Committee. Pushing, which includes pulling, is treated in all the great series of "Transactions" which deal with the transmission and use of force, whether by fluid, gear, rope, or chain. But hammering, which involves impact, has had but little attention. The first paper on the subject was read in 1854[1] by one James Kitson, a Member of the Council of the Institution from 1855 to 1863. Will you be lenient with his grandson if he makes it a family subject and returns to it after two-thirds of a century have passed?

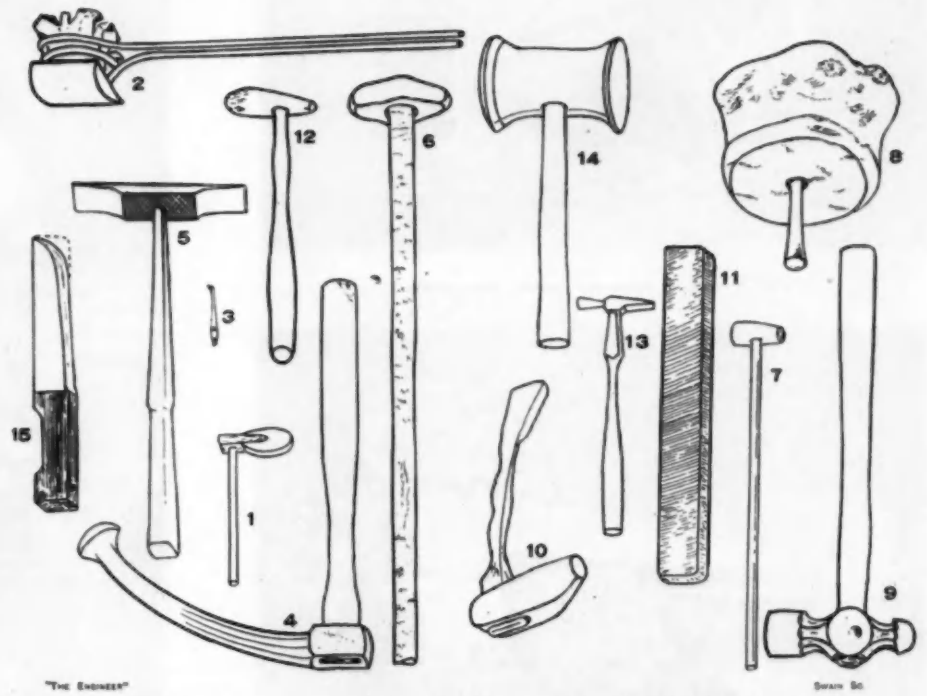
Material of Hammers.—Palæolithic and neolithic men developed a skill with the hammer upon which we have not space to dwell to-night. The men with the technique of the Stone Age were later either destroyed, dispersed, or educated by those who had learnt the art of working in bronze. Examples remain of bronze hammers, rather of the pestle type, but bronze wore rapidly away, and was readily recast by the founder, so that not much evidence is preserved of hammers of that civilisation which immediately preceded the introduction of iron.

With the forging of iron the hammer head could be made in any shape that the form of the article manufactured required, and the infinite variety began which has been carried on with an unintermittent and expanding series to this day.

Heads of Hammers.—Hammer heads have a variety in shape which is surprising, as any trade catalogue will show. We can only notice a few; but we cannot fail to start with the "Monday" hammer, called after Monday the least-loved day of the working week; 28 lb. it is in weight. There is in the Dales of Sheffield a superlative Monday hammer, which weighs 140 lb., and was used for breaking scrap—an heroic implement described in one homeric sentence: "Me and my mate lifts it up, and the Lord sends it down."

Turning to more prosaic life, we take the first example—No. 4, Fig. 1—from the trade of the coppersmith, the master through all ages of hand-hammer work. The shape explains itself; it is used for dishing a hemisphere. The flint knapper is at work at the present day on the same ground as that on which he worked 4000 years ago; but now he uses a narrow-edged steel tool—No. 5, Fig. 1—of the width of the flake that he requires. He is making quantities of flints for striking fire.

A stone-breaker's hammer—No. 6, Fig. 1—appears



1. Piano hammer.
2. Boilersmith's sett.
3. Dentist's gold stopper.
4. Coppersmith's hammer.
5. Flint knapper's hammer.
6. Stone-breaker's hammer.
7. Indian agate knapper.
8. Stone-mason's hammer.
9. Mechanic's hammer.
10. File-cutter's hammer.
11. Cobbler's hammer.
12. Dental plate hammer.
13. Dentist's riveting hammer.
14. Gold-beater's hammer.
15. Worn disintegrator blade.

FIG. 1—HAMMER HEADS

disproportionate in its component parts, the shaft being two-thirds of the weight of the hammer head. A blow has to be struck on a small face at a considerable distance from the operator. There is an interesting little hammer—No. 7, Fig. 1—also employed upon stone, which is used by Indians for snapping off portions from an agate gem. Its handle is a very thin stem of bamboo and the head a small block of buffalo horn.[2]

The stone-mason's hammer—No. 8, Fig. 1—by contrast has a large head on a tiny shaft, the size of the head rendering the meeting of the hammer head with chisel head more easy. The material, being wood, provides, like the buffalo horn, a certain resilience which extends the time of the flow and by jarring the chips from the stone prevents a dig-in. The joiner, too, obviously requires the same characteristic in his hammer head, because a fibrous material which is worked upon demands time for separation. The mechanic, on the other hand, in dealing with iron or steel, employs a quicker action and requires a hammer head—No. 9, Fig. 1—whose unobtrusive design really embodies considerable experience.

The file cutter plies his remarkable hammer—No. 10, Fig. 1—with a motion that presents to the calculator a very attractive series of problems.

The file, once produced, plays its usual part, and then sometimes rises to hammer rank itself in unexpected hands, for you see it wielded by a cobbler—No. 11, Fig. 1. He swings his tool from a centre level with the point of application and drives his nails with remarkable rapidity, catching the heads almost as they balance on their points. It is indeed a technique of notable dexterity.

Then there is the plumber who beats his lead to the shape required, by a curious wooden mell. The plumber and his work, like his method, cannot be disregarded, but both are beyond analysis, and we may leave them at that.

There is another soft material which often attracts personal interest, and that is the gold with which dentists are occasionally good enough to ornament one's mouth. The horn hammer—No. 12, Fig. 1—is used for forming the plate. Its head is harder and more durable than wood, less severe than steel. The tapered end treats the portions between the teeth, the rounded end inside the palate. However intimate the interest of this implement, let us leave the distressing subject.

The hammer which comes last but one on my list is of a surprising character. Missionaries have described how in China a workman will weld a broken boiler by inserting drop by drop small gluts of melted iron into the crack and stroking the metal that protrudes with a small roll of felt covered with ashes. This is an instance of hammering that I should never have looked for, and makes one think of piece-by-piece fusing, which is now coming into practice at the hands of electric welders.

There is a trade that perhaps might be described as hammering *par excellence*. To be able to reduce a piece of metal to 1/280,000th of the thickness from which a start was made is indeed a feat, but the gold-beaters have been doing work of this kind since the time before history began. A bar of gold, about 2½ oz. in weight, is rolled to a length of 6½ yards and cut into pieces 1in. square. This is the "cutch" piece. One hundred and eighty are piled in the cutch and beaten to 3¼in. square—half an hour's work. The finished cutch sheets are cut in four and put in the "shoder," comprised of 700 skins, and beaten out to the edge, say, 4in. square—two hours' beating. The shoder gold is lifted out, cut into four and put into a mould 5in. square. This takes five hours. A thousand pieces are beaten at once between a thousand skins. The resulting leaf is 1/280,000-inch thick. The centre is cut out to 3¼in. square, placed in books, and sold for use.

Power Hammers.—The translation of the Oliver into a power-driven machine was not done for many years, but when the design was made, the hammer head was actuated by a rod attachment to a slotted link. The link was reciprocated by a pin on a revolving crank. The effort of starting the hammer from the anvil from rest was rendered easy owing to the locus of the pin in its circular path. The variation of blow was obtained by the position of the connecting-rod in the slot. The novelty claimed for this hammer lay in the possibility of moving the position of the head transversely by means of bevel mechanism.

I can give no account of power hammers earlier than those which were used for shingling blooms in iron forges. The ancestors of these glorious monsters go back to the sixteenth century. One, of which a photograph is shown—Fig. 2—has been at work since 1644, and some of the productions were cannon balls actually used by Oliver Cromwell in the Marston Moor campaign.

* The Institution of Mechanical Engineers. Address by the President, October 23rd, 1931. Much abridged. Many exhibits were displayed.

[1] "Proc.," I. Mech. E., 1854, page 133.

[2] "Indian State Railways Magazine," Vol. IV., page 319.

The principle is that of a heavy head swung on the end of a pivoted shaft or helve. The head is lifted by projections or cams on a wheel revolved by water. There are three methods of application of the cam. In the earliest type the lift by the cam was at the neck, that is, between the head and the pivot, and close to the head. As the helve was a forging and as the need for blooms became heavier and forgings were limited in weight, it was necessary to reinforce the blow of the head by a spring timber which was placed above the helve. Against this the head struck and rebounded on to the work. The average weight of the blow would be about half a ton and the speed sixty to ninety blows per minute.

By means of the improved skill of the forgemen, forgings became larger, larger helves were introduced, and the weight of the whole machine was increased and the spring systems and the rebound attachment became unnecessary.

The next instance—Fig. 3—shows a helve of larger type, capable of giving a blow of 1 to 2 foot-tons. This hammer is also raised at the neck and also used for expelling the molten slag from wrought iron blooms. In this instance the plane of revolution of the cam ring and water wheel is at right angles to the movement of the helve. The hammer shown has been working regularly for 150 to 200 years.

In a type which is still heavier and later—*circa* A.D. 1800, Fig. 5—the lift is again at the neck, but the power plane is parallel to the plane of movement of the hammer. The workmen could move thereby all round the anvil, and under it the first railway axles were forged from wrought iron.

In a further instance—Fig. 4—the helve is of wood, iron hooped, and the hammer head is lifted or "tilted" by pressure at the tail of the helve beyond the pivot. The power of the blow is reinforced by the tail of the helve being thrown against a "stithy" or anvil, causing a sharp rebound at the hammer end. It will be evident from this action that the faster the hammer goes, the greater the rebound and the heavier the blow which results.

Behind the tilt hammer is associated an important auxiliary — Fig. 6. Its helve is lifted at the nose. Its cams, which are driven on the same axis as its principal, are set at greater intervals, so the work is slow and heavy, the blow being from 2 to 3 foot-tons. The auxiliary—nose-lifted—roughed the ingots and the principal—tilted—finished the bar.

The pivot upon which these magnificent limbs or helves are swung is provided by the tapered circular ends of a flat bar driven through the centre of the helve. These pencil-ends work in corresponding taper holes provided by the housings. The housings are capable of nice adjustment by means of wedges. The only object shown in the views is a scythe blade, but the heavy and yet tractable hammer blow of the larger hammers, combined with the squeeze as it rested awhile on its bloom, rendered these old types of hammers invaluable for welding together the plates of Blister steel. Thus the Sheffield forgers produced the famous double-shear steel which was the basis of all the finest Sheffield cutlery, previous to the advent of stainless steel.

The tilting mechanism was developed on the small as well as on the large scale. The speeds attained varied with the length and weight of the hammer from ninety blows per minute to the surprising rapidity of over 1000 blows in the case of the small cutlery forging or "goff" hammers. Of these, there are now none in use, the last being dismantled a few years ago in favour of the spring type of hammer.

The action of tilting of a hammer has, however, given a generic name to the process of forging by rapid blows, independent of whether there is a tilting arrangement or not.

There came a day when the work required was too big for the capacity in size and power of the fine old helve. For the Great Western Steamship Company an enormous paddle shaft of 30in. diameter was required. Mr. Nasmyth is recorded to have designed a steam hammer for the purpose, though the work was not carried out, for a screw propeller was substituted for the paddle in the ship.

Monsieur Bourdon, of the Creusot Ironworks, visited Nasmyth's works in the absence of the latter. He was shown the drawing of the hammer whose head was directly propelled by steam. The hammer had not been made. Subsequently, Mr. Nasymth, when visiting Creusot, saw a steam hammer at work, and for this the proprietors gave him full credit. Mr. Nasmyth took out his patent in 1842. Thus did the steam hammer come into being. It had, indeed, been born on paper before.

James Watt had a patent dated April 28th, 1784, for "Heavy Hammers or Stampers," fixed either directly to the piston or the piston-rod of the engine. Mr. W. Deverell on June 6th, 1806, patented an invention by which steam was to be raised in a boiler having a steam cylinder with a piston and rod in it, and at the end of the rod was a hammer. The steam from the boiler was to be let underneath the piston by means of a cock. The air at the top of the piston would thus be compressed by the superior pressure of the steam. After the piston had been raised, a vacuum would be formed and the compressed air on the top of the piston would then force down the hammer with a velocity proportionate to its compression.

When steam hammers were first made the manipulation entailed unduly heavy work upon the operator, and though an automatic valve motion was added, they were still not a success. It was required that the instant the blow was struck the hammer should again rise. It was thought that an automatic arrangement could be introduced, but a difficulty emerged in that as the piece on the anvil became thinner and thinner, a variation of the automatic device would be required. Further, with flat bars, the blow has to be given first on the flat side and then on the edge, the difference in the fall of the hammer in the two cases being often several inches.

Mr. Wilson, the manager of Messrs. Nasmyth's works, then introduced a scheme in which the position of the fulcrum of the lever was altered by means of screws, so that a blow of the exact force required could be produced. This type of hammer was used from 1843 to 1853 when Mr. Wilson, then at the Low Moor Ironworks, patented the "circular balanced valve." This valve floated in an atmosphere of steam, so that movement was actuated "as easily as lifting a finger." So the mechanical automatic process ceded once more to the definite guidance of a man's hand and with satisfactory results. Subsequently, the hammer was capable of striking 500 blows a minute, the block being raised 6in.

Steam, expansile, compressible, almost human in its adaptability, could by means of a piston in a cylinder, pick up a hammer, drop it, or thrust it down. The government of the steam was a matter of different methods of valve manipulation—interesting and difficult and therefore too much diversified to be compressed into these pages.[2] But one curious novelty is to be noted. Mr. Condie, of Glasgow, holding that pistons failed and had to be replaced too frequently, fixed his piston and put the hammer head on the cylinder itself which he moved up and down. The number of new cylinders that his customers required is unknown; I suggest not more than one.

There have been hammers, that is machines which owed their effect to impact, which used steam, oil, water, gas; but we will pass from them to compressed air, for we find it employed in the largest of all hammer creation—the giant at Terni in Italy. The whole installation was 69ft. 2in. in height. The legs were planted on four feet. Below the apex of the pyramid a cylinder was placed, 6ft. $3\frac{9}{16}$in. diameter, and 9ft. $10\frac{1}{2}$in. stroke. The rating was stated to be 100 tons. But the greatest interest is in the anvil, which weighed 1062 tons. The depth of the excavation in which it was placed was 32ft. 6in., at the bottom of which a concrete bed was laid above the series of piles. On the concrete, ashlar stone; above the ashlar stone, and embedded thereon, a plate of cast iron, about a ton in weight, and erected in the centre of this plate a shaft 6in. in diameter. The object of this shaft was to prevent the formation of a pipe in the

FIG. 2—HELVE HAMMER WITH TOP SPRING

FIG. 3—HELVE HAMMER WITH CAMSHAFT AT RIGHT ANGLES TO HELVE PLANE

FIG 4—TILT HAMMER WITH WOODEN HELVE

[2] "Etudes sur les Marteaux-Pilons," Soc. des Anciens Elèves, Ecoles Nationales d'Arts et Metiers, January, 1888.

centre of so large a casting. Above was laid a brick base 20in. thick, and starting from this level a mould was built round to form the shape of the anvil. This foundation thus took up 17ft. 11½in. vertically, and the height of the anvil was made 14ft. 6in., with a base 19ft. 1½in. by 28ft. 11½in. The lowest stratum of the iron massif was then formed by the distribution thereon of 80 tons of pig iron. On to this pig iron in the first event, 693 tons of molten metal were poured, the casting lasting twenty-four hours. Thirty-six hours later the second delivery of molten metal began, and in seven hours 289 tons were poured. The heat of such an enormous mass and the length of time it took to cool, would be an experience of which one would like to have further information.

Commenting further on the Terni hammer, size and performance had now grown to such a scale that it will be no surprise to find the system superseded and that a press of greater effect sits under the canopy of even that great quadruped.

In the well-known swaging machine, the stroke is ½in., the number of blows rising to 1100 per minute. The drive is positive. An excentric shaft thrusts the hammer down upon its work. The resilience which is required between the beater and the beaten is cared for by the elasticity of the machine standards. A heavy spring is inserted below the driving members which raises the working parts after the blow up to their bearing on the shaft. Of this upward working stroke the first half is delivered by a 700 lb. spring, the second half by a 200 lb. spring This machine is a bold device and invaluable to all those who forge quantities of small work.

Another hammer which makes provision for relief of jar in a blow is the power hammer that is used in Sheffield for forging files, edge tools, &c. The force here again is given by a positive crank, driven by a remorseless fly-wheel. The tup is carried on straps or jaws on the end of a spring so that two effects are produced: (1) The blow is intensified by accumulated force as the tup is cast down; and (2) the yield of the bow in the middle of whose spring the tup is held, permits the hammer to deliver its blow without an undue jar on the driving mechanism.

Certain forgings, however, require a blow whose effect is helped by a dead load that remains on the object after the blow is given. In such work the drop-stamp comes in. An early treatment of the problem is shown in the "Improved Friction Hammer," described by Mr. James Kitson before you in November, 1854.[4] The hammer block weighed 5 cwt. Into it was fixed vertically a flat wrought iron bar, 5½in. wide, ⅝in. thick. This bar passed between two rollers, one continually running, the other loose on its axis. The loose roller could be moved up to the bar or away from it by the operator. In lifting the weight this loose roller produces a gradual grip on the bar and the initial heavy stages of lifting were accomplished without a sudden jar by reason of the slip of the bar between the rollers. Beside his control of the gripping rollers the operator could actuate a friction clip which served to check the hammer and hold it fast at any required height. The whole was mounted upon four india-rubber springs for the purpose of relieving the friction bar and shock at the time that the lifting rollers laid hold of the bar. The difficulties involved in this early machine were connected with wear of the bar and breakage of the fixing connection, and the manner by which they were overcome seems to have been of sufficient novelty at that time to deserve the distinction of a description before our members.

It does not appear necessary to develop the story of the drop hammer as the ordinary characteristics appear to be portrayed in this simple early story, the problem being, as always, to make a mechanism have the versatility of the hand-actuated implement. The interest, therefore, of this early drop-stamp is perhaps of some technical as well as personal value.

A blow has played its part in Civil Engineering. The balks of Cæsar's famous bridge, 1½ft. square, 40ft. long, were driven into the bed of the Rhine by a fistuca. Pile-driving, moreover, has proved essential for the foundations of many mediæval as well as modern buildings. It is unnecessary to do more than mention, for instance, the Campanile at Venice, and the record of the most modern example, where a great motor-making factory is being placed on the side of the Thames, will surely be of interest as being perhaps the last word in scientific pile-driving. The lantern slides which I show of the photographs taken by the Ford Motor Company indicate that much more remains to be said on this subject.

Conclusion.—The story is thus partly told. These are but paragraphs in the history of the hammer; there are chapters on the subject or related subjects such as the illustrations by da Vinci, called "Phénomènes divers du choc," elsewhere, which lie beyond the limitations of this address.

But there are no limitations to an engineer. I have been invited at successive banquets in the character of your representative, to stray into geology chemistry, almost into law, and even into politics. I have been told that without such direction posts, no profession can travel on in safety. But I pass by the openings of these avenues; yet into history and literature there are attractive paths, down which a little way I would like to follow the journey of humanity under the hammer.

The traveller beyond the bounds of history finds stone hammers of his palæolithic ancestors, or later the wooden *casse-tête* of the neolithic lake dwellers. He turns to a period when fiction straggles into fact, and myth merges into human experience, and he sees the hammer of the god Thor. Thor, the thunder god, wielded a hammer. He used it as a club, he hurled it through the air, and by its special virtue he brought it back to his hand.

For this exercise the handle was short. Now, it would seem that this shortness was unusual so the story-tellers required a legend to explain it. A wager had been made between a dwarf named Brokk, who was also a smith, and a god named Loki, who was also a mischief-maker. As the former was forging the hammer—which was the subject of the bet—the latter settled as a fly on the eye of his assistant, the bellows minder, who thereupon ceased blowing in order to catch the fly. The air supply was stopped, and the hammer was incomplete, and that is why the handle was short. And, being short, it could be used in fighting. So with this rare implement Thor slew all the giants, fellow-guests at a wedding party. And that, I suppose, was to the advantage of Mankind. But it would seem that a hammer was not the accepted weapon, according to story, among early Germanic people. And similarly among the Greeks the fighting value of hammers is not carried much beyond the tales of Hercules.

In the Bible, too, the actual use of the hammer was less to destroy undesirable people than to scrap undesirable material, *e.g.*, "Thou shalt break them in pieces like a potter's vessel." The action of Heber's wife, Jael, who put her right hand to the workman's hammer in the matter of the sleeping Sisera, appeared somewhat unorthodox.

Charles, named Martel, the soldier that stopped the deluge of Europe by the Turks in 732, was called Martel "the Hammer." This attribution, it is supposed, was rather in view of his hammering his raw military material into shape than in respect of his use of it as a mace. The mace came to its own at a later time, for instance, when Richard Cœur de Lion, according to an early ballad, suffered at the hands of a baron a redoubtable hammer-blow—

> "and for that stroke that hym was geven
> He no wyst whether it was day or even."

Moreover, there lies in Westminster Abbey, Edward I. of England, written there as Malleus Scotorum; and there is another king whose portrait is known to every member of civilisation, whose proper weapon is a mace. His emblazonment, it is true, is a sword as being more proper to Royalty—but he is the King of *Clubs*.

So much for the hammer as a weapon. As an implement of correction in the cause of law and order, the hammer appears everywhere. There is the mark of authority in our House of Commons. There are the field-marshal's baton, the mace of our mayors, the policeman's truncheon, and so on, down to the schoolmaster's or father's impactifer—not unknown, perhaps, to my audience, whether subjectively or objectively, I do not ask.

A hammer calls the members of the Institution to attention, a hammer completes a bargain at a sale, a hammer ends a career on the Stock Exchange. And now on the latest national escutcheon the emblazonment is a hammer and sickle.

In metaphor the motive of the hammer is no less common. Herodotus, the Greek traveller and historian, quotes remarkable words that the Pythian priestess used in answer to a city's request for counsel, She bade the petitioners seek such and such a place. which they would identify by a smith's forge; and she hid her advice in a poetical analogy from his craft. Thus she said:

> "There is a place stark stress-driven
> Where twain winds are ever a-blowing;
> Shock makes answer to shock
> And anguish is laid upon anguish."

The twin winds are from the bellows, the hammer and anvil act and react, and the whole piles sorrow on sorrow. Plautus, the Roman comedian, made one character in a play gird at another: "Without me," he sneered, "you will be about as much use as a hammer with the handle gone."[5]

It etymology, moreover, the thread of connection runs through nations and languages. Our "hammer" means stone or a piece of stone, and the Greek for anvil ἄκμων is allied, the κ and the μ being surprisingly close to H and M. Thor's hammer was called Mjöllner—akin to Malleus and Maul. So by actual word pedigree we come back to the beginning of our story of to-night. But the path of etymology was never advertised in after-dinner speeches. I go no further along it. I take a bolder range.

Mr. Pendred is the explorer whom I follow in space as in time. Did he not tell us a year ago to keep our eye on Physics? I try to follow his vision and shod with the sandals of ignorance I turn thither to inquire for a way. And I ask: In the wonderful house of Physics, what do they say of impact? First, I find Lucretius speaking about 2000 years ago. He wrote that all atoms were moving downwards. Then something jarred them in their course and the material universe was fabricated. Otherwise he held "that no body would ever have been aware of another body, everything would have been predestinated and human beings, if any, would have no free will." And now, those of us who have his original thought in mind and who try to follow afar off the mental pictures that are drawn for us by the great leaders of to-day, seem to catch an echo of the Roman poet in their teaching that the essence of material things is bound up in the clash of electrons.

I did therefore venture to put a question to a friend of mine, a very distinguished physicist—rushing in, I stepped (apologetically) where angels feared to tread, and asked whether one could imagine that the Hammer Effect was the cause of life, that while Existence was simple Movement, Life was Collision, the birth of something from stored energy. "As a physicist (*alias* angel)," he replied, "he dared not venture after me even with caution." But he did not dismiss the phrase "stored energy" that I had used. Let us then believe in successive increments of force, let us not reduce Time to a mere co-existent formula,

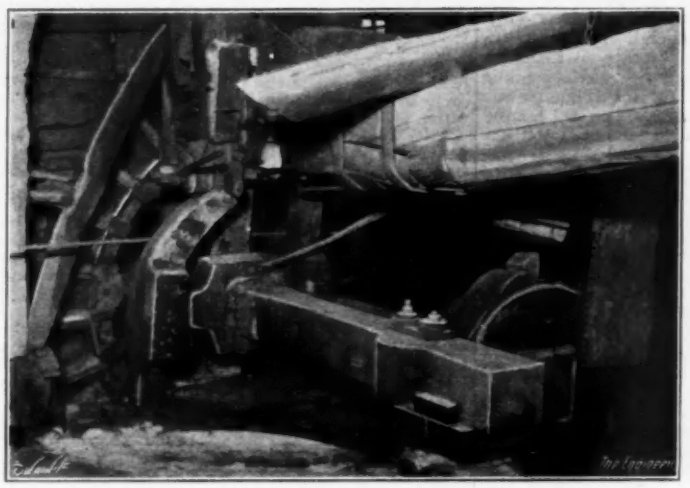


Fig. 5—Helve Hammer with Camshaft Parallel to Helve Plane

Fig. 6—Nose Hammer Auxiliary

[4] *Loc. cit.*

[5] The Epidicus.

the accident of a fourth dimension. Let us not accept the uninteresting Utopia of the hyper-mathematician. For we engineers are sympathetic to Time, we think it means a series of phenomena; we see how energy is accumulated and released whenever man strikes a blow with a hammer, and we are assured that such a succession fits most closely to our own conception of our relations to the changing conditions of life; for we feel that because Time goes on we also go on, we strive in difficulties, we seek interest in adventure.

At the outset of this evening I called you back from the fascinating aspirations suggested by my predecessor, to view the harbour works rather than the unknown sea to which he turned your gaze. In fact, I claimed you for the sober rationale of tool making, and now that plain story, too, has, I find, become a philosophy. It, too, reaches towards the intangible, so that while it is the clear function of the engineer to obey, to give orders, to execute, to criticise, to design, to hustle and yet to wait, to have caution and yet daring; while it is for him to solve acknowledged problems, I claim that he must ever remember that there is something more than the accepted programme, there is the *search* for problems which ought to be thought out. We have set out to mechanise the world, that seems to be our accepted programme, we must not—and thank heaven we cannot—dehumanise it. I hope that I have found in the romance of the simple hammer some essence of principles which are by no means settled, even some reflection of the greatest issues of existence. I hope that in these concluding words I may stir in you a restlessness that will direct you into lands of uncertainty. May I ask you, gentlemen, to pause at times and look as from a distance at the patterned landscape of your ordinary life. Complicated it may be—difficult country it certainly is at this time, but still it is comparatively obvious. There is a world beyond—there are unforeseen things that will arise in the forge of life from the ceaseless blows of mental contact and social collision. And as we play our part in the great purpose of this world a small part may be for us in that unknown. Let us not, therefore, be quite satisfied with achievement that we know of, and success that we see before us. Let us reverence the unknown, determined wherever we may find ourselves to be ready to strike a blow *mente et malleo*, outside the routine of our allotted task, and try to carry even more than our part of that divine burden placed upon every nation, every family, on every kind and true heart, on every engineer, to leave the world a better place than we found it.

The Wages Problem.

The trouble in fixing wages is due to its being regarded as a purely national matter, without reference to the possibility of maintaining such wages in the face of conditions existing elsewhere. The problem has been complicated by the theory of higher wages which we owe to the United States, and by a "standard of living" that is based upon an arbitrary appreciation of conditions that are essentially variable. There is lacking a method of comparison with the wages paid in other countries, for upon them depend largely the competitive advantages of foreign producers and the purchasing capacity of other markets. No one, of course, suggests that wages in Great Britain should be reduced to anywhere near the level of those on the Continent, but there is a difference between the wages actually paid and their purchasing value, and attempts are now being made to establish a basis of comparison that will allow of the wage factor being more accurately determined in international exchanges. Owing to the great variety of social conditions throughout Europe, such a comparison is only possible by means of an extensive investigation. This is being undertaken by the International Association for Social Progress, which held its fourth general assembly in Paris last week. At the Liége meeting in July of last year it was decided to send to all the national sections in Europe a questionnaire dealing with the different factors influencing wages, and the final discussions upon the report, and the conclusions to be drawn therefrom, will be reached at a meeting to be held in 1933. A few reports have been received, and one from the British Section was presented at the Paris meeting. As the data so far available are incomplete, nothing can yet be done to determine a method of international comparison of wages, nor is it possible to establish a basis of minimum wages, which is one of the objects of the Association's inquiry. Therefore, a preliminary report on wages fluctuations was prepared by Dr. Ludwig Heyde, Professor at the Kiel University and member of the Economic Council of Germany, whose scientific treatment of the subject leads to conclusions that are perfectly in agreement with those adduced by practical considerations. Under static conditions—that is to say, where a country produces mainly for its own needs and there is a limited expansion of demand—an increase in wages may benefit the worker for the time being, but, as that entails higher selling prices, the consumer has necessarily to restrict his purchases, and there is less saving and less accumulation of capital, with the result that the interest on capital increases. A higher cost of production leads to a weakening of national economy, and an advance of wages, by raising selling prices, conduces to unemployment. If the producer seeks compensation for higher wages without loading it on the selling price, he can only look to economies in raw material, transport and interest on capital; but hope of alleviation in that way is generally illusory. Therefore, if wages are increased the worker must produce more, but in that case there is a limit to consumption under static conditions, and while the men at work may be encouraged to produce more with higher wages, there are others who are thrown out of employment with little prospect of finding work elsewhere.

These conditions apply to cases in which the consumption of particular products is limited by national needs, but when possibilities of an expansion of demand in export markets exist there is still a wide range of influences that may cause great fluctuations, and even a partial suppression of requirements, with the result that there remains an absence of stability in the fixing of wages. The connection between capital and wages is particularly insisted upon by Dr. Heyde, for if capital is scarce the manufacturer is less able to develop his business, effect economies and pay higher wages. The direct interest of the worker is to welcome a circulation of capital which will improve his condition. Another matter developed by Dr. Heyde is the effect of technical progress on wages. This progress, he says, cannot always compensate for higher wages, because there are technical problems that, at a given moment, may not be ready for solution, and because many technical innovations involve too heavy an expenditure of capital to allow of higher wages being paid. Dr. Heyde goes further, and declares that it is not always advisable to economise labour by technical progress rather than to lower wages to avoid unemployment. Technical advance exerts a "demoniacal influence" which tends to create an exaggerated idea of the markets' capacity of absorption. The report of the British Section is based largely upon statistics and official documents down to the end of June last, from which it appears that in the engineering industries the wages paid to fitters at the end of 1930 were 52 per cent. above the pre-war level, while the increase for unskilled hands was 84 per cent. The wages of dockers increased by 100 per cent. and of permanent way labourers 109 per cent.; but, having reached the peak in 1920, there has since been a decline of from 30 to 50 per cent. in unsheltered trades and of 20 to 35 per cent. in the sheltered industries. The reductions have affected unskilled workers relatively more than the skilled hands, though, compared with the pre-war level of wages, unskilled labour has still an advantage.

The British report is based upon facts having a purely social significance, and is a plea for higher wages, with reservations which show that the difficulties in the way of carrying out this policy are recognised. There is no question of increasing production costs as a means of paying higher wages, but a good deal is said about economies that can be effected in manufacture whereby the men can be remunerated on a higher scale. The manufacturer usually knows more than any one else how best to carry on his business. If he sees that economies are possible he will readily carry them out, but the influence which such economies can exert on wages is small. A closer collaboration between employers and labour is desirable as a means of stimulating the men's interest in their work, so long as it does not result in actual interference. By increasing the efficiency of labour this may have a marked effect on the amount received by workers, but it does not provide a positive factor in determining the rate of wages. There are no devious roads to higher wages. They depend upon the one factor of what the manufacturer can get for his goods. If capital is cheap and the manufacturer can produce goods in larger quantities at a price at which he can sell them freely, the larger aggregate profits on bigger sales will enable him to pay more to his men. Should, however, the manufacturer find himself forsaken by capital and faced with a dwindling market, nothing can save the men from lower wages or unemployment. Nor should it be forgotten that the cost of selling goods is greater now than it has ever been. This adds to the already heavy burdens on the manufacturer, and makes it very doubtful whether the policy of higher wages is capable of being put into effect. The conclusions of the British report in favour of higher wages are presented in a way that reveal little belief in their practical value, for it is admitted that they cannot be adopted except by international agreement, and the prospect of all countries accepting a general standard of wages is so remote that it may be abandoned. When British workers understand that a policy of higher wages and a high standard of living is really a policy of trade expansion, in which they should co-operate whole-heartedly, they will be in a fair way to improve materially their situation.

In a report recently issued by Major H. Hamer, the City Engineer of Hull, reference is made to the maintenance of the 15¼ miles of unsurfaced concrete roads within the city. The total cost has been £80 19s., spread over a period of seven years, the expenditure having been necessitated on three roads only. On five roads totalling over 4¼ miles, and laid up to over six years ago, the expenditure has been nil.

A Large Traction Cable.

An exceptionally large wire rope has just been supplied to the Glasgow Subway Railway by the Whitecross Company, Ltd., of Warrington. It is in one continuous length of 7 miles, is 4¾in. in circumference and weighs 53¼ tons. It required eight weeks to make the rope and it provided occupation for a hundred men during that period.

The rope, which has an ultimate tensile strength of 70 tons per square inch and an actual breaking load of approximately 57 tons, must, naturally, be flexible and have a high fatigue value to withstand constant bending under tension, while a high degree of resistance to wear and abrasion is required on account of the use of slippers to connect the tramcars to it. These properties have been attained by means of the heat treatment of the wires and special methods of wire-drawing to develop the required grain structure. The steel was metallurgically examined and microscopically investigated at every stage of manufacture.

The construction of the rope is six strands each of nineteen wires closed around a manila core. The wires in the strands are arranged on the Seale pattern, of nine large outer wires over nine smaller wires, over a steel centre wire, the wires being all laid up at one operation in line contact, to prevent internal cross cutting. The lay of the rope is Lang's, *i.e.*, the wires in the strands and the strands in the rope are all laid up in the same direction.

Joints in individual wires were necessary because, whilst the wires are run in the longest possible single lengths of over 1¼ miles, and weigh about 250 lb., a number is, of course, required to make up the length of the rope. The joints were made by a special brazing process developed by the company. The whole rope was laid up in one operation and finished on the reel, without any joints other than the brazed joints in the individual wires at intervals as mentioned, of about 1¼ miles. The brazed joints were carefully spaced at long intervals throughout the different wires of the rope. It is important that the interior of the rope should be thoroughly lubricated during manufacture, and a dressing of special cable grease applied to the surface when the rope is put to work.

The variations permissible in the diameter of the rope are governed to some extent by the variations in the diameter of the individual wires, which are, nominally, plus or minus one-thousandth of an inch; but as these tend to cancel out in the 114 wires of which the rope is composed, the overall finished diameter can be kept to within plus or minus five one-thousandths of an inch.

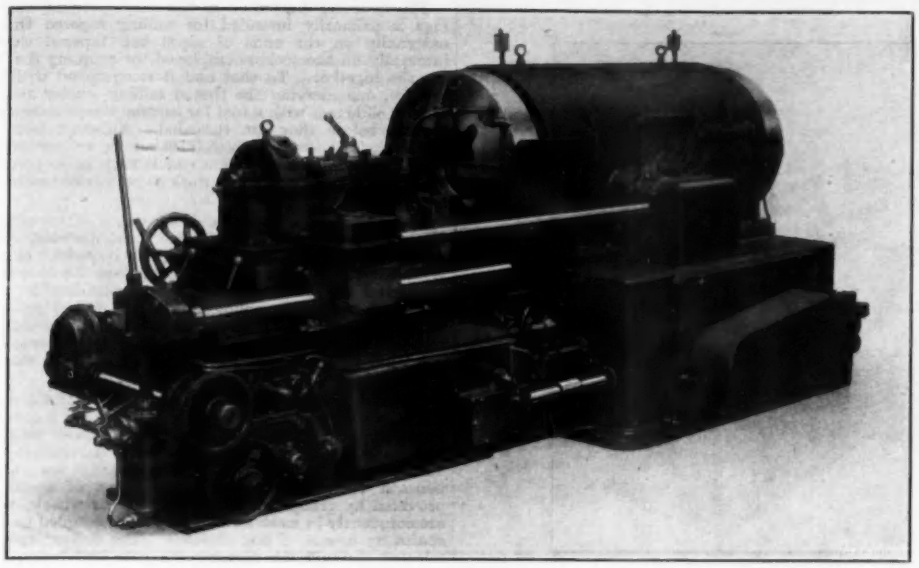
After installation, the ends of the rope will be spliced together to make an endless track rope. The length of the splice will be about 78ft. overall. At the engine-house, the rope passes over a friction driving drum, which provides the motive power for driving it around the track, at a speed of about 13¼ miles per hour. Each train consists of two cars coupled together, and the leading car has a slipper attachment by which the driver engages the rope. Eleven sets of these cars are in use continuously on the track in each direction.

Whilst the rope was manufactured by finally winding on to a reel, the weight in this form was too concentrated to be sent by rail, and for its journey from the works to Glasgow it was, for convenience, uncoiled and laid into two cradles, fitted up in extra heavy 35-ton bogie wagons, about 28 tons being put in each.

SIXTY YEARS AGO.

The first article in our issue of November 3rd, 1871, gave the results of the trials of steam cultivating machinery, which, in the summer of 1871, were held under the auspices of the Royal Agricultural Society at Wolverhampton. The exhibits included over twenty sets of engines and ploughing tackles, among the makers of which we find such household names as Fowler's, Howard's, Clayton and Shuttleworth's, Amies and Barfords' and other firms, then equally well known in the agricultural machinery trade. One whole page of The Engineer was devoted to a table setting forth the performance results of the cultivating sets, both the indicated figures and the field observations being recorded. The judges were Mr. Easton and Sir Frederick—then Mr.—Bramwell, who acted in conjunction with Mr. Menelaus. Some further observations with regard to the tabular records by Messrs. Easton and Anderson, the consulting engineers, are also given. These trials, we said, marked the most careful and elaborate set of experiments ever carried out up to that time by the Royal Agricultural Society. In the same issue we chronicled the death of Mr. James Easton, the senior partner of Easton and Amos, who for many years were consulting engineers to the Royal Agricultural Society of England. They also carried out many interesting and important works, including the cleansing of the Serpentine, in St. James's Park, which was effected in 1857. Mr. Easton also advised the Government with regard to sinking an artesian well for supplying the fountains in Trafalgar Square and Government offices with water. His firm was also responsible for the machinery used for raising the Britannia and Saltash bridges and the Conway Bridge for Mr. Robert Stephenson and Mr. Brunel. . . . In the same issue Mr. Merrifield, then secretary of the Institution of Naval Architects, appealed for papers for the forthcoming session, and gave a list of subjects. Unlike the present day, when the papers read are of a high order, we said that we hoped that the result would prove satisfactory, as, with very few exceptions, nothing could well be worse than the papers recently read. On our leading article page we discussed the question of intercommunication in railway trains, while a feature of that particular issue was the large number of answers to correspondents on our title page. The Editor was asked to give information with regard to stone cutting machinery, the use of enamelled pans for boiling acids, and to name the best maker of machinery and ovens for the manufacture of ships' biscuits.

McLEOD-RICHARDS THREAD MILLING MACHINE



The McLeod-Richards Thread Milling Machine.

Two principal methods, differing radically from each other, are employed for carrying out the process known as thread milling. The older method makes use of a cutter, on the cylindrical surface of which there is, not a thread, but a series of parallel ridges of the required thread section and pitch. The ridges are gashed and relieved to form cutting edges. Initially the cutter, rotating at a high speed, is fed radially against the stationary work. When the feed reaches the full thread depth the work is slowly rotated and is simultaneously advanced at such a rate that at the end of one complete turn it has moved longitudinally through one pitch distance. Alternatively the longitudinal motion may be applied to the cutter. In either case the initial gashes formed during the preliminary

FIG. 1—PRINCIPLES OF RICHARDS' SYSTEM

feeding-in process are extended spirally round the periphery of the work and join up with each other to form a complete thread. The work is therefore fully threaded after it has made one whole turn.

The second principal method of thread milling is that invented by the late Mr. George Richards. Its underlying principle is doubtlessly familiar to many of our readers. We dealt with it in some detail in our issue of October 3rd, 1919. Briefly, it turns upon the fact that if two cylinders —Fig. 1—of the same diameter and threaded to the same pitch are engaged and allowed to roll down an incline they will arrive at the foot without exhibiting any relative endwise displacement. If then the two cylinders are mounted on parallel axes and are rotated in the same direction at equal speed, and if one cylinder is plain while the other is threaded and gashed, then, when the one is fed radially against the other without relative endwise move-

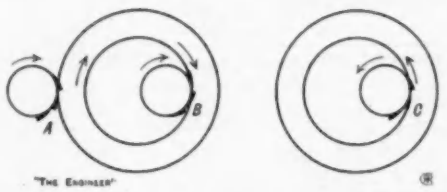


FIG. 2—EXTERNAL AND INTERNAL THREADING

ment, the plain cylinder will eventually have a thread cut upon it equal in pitch to that on the cutter cylinder. The inward feed is continuous during the Richards process and the thread is not completely cut until after the work has made several turns.

It is clear that the two cylinders, when they are mounted on parallel axes, need not be of the same diameter. A thread of the pitch on the cutter cylinder will be copied on to the plain cylinder whatever be the relative sizes provided the two cylinders are rotated at the same number of turns per minute. It is also clear that the cutting speed is equal to the *sum* of the peripheral speeds of the work and cutter.

The same principle is applicable to the milling of internal threads. If a bolt and nut are rotated at equal speed in the same direction the nut will not move relatively to the bolt. Let the nut be replaced by one of a larger size, but threaded to the same pitch. Rotation of the nut and bolt at equal speed in the same direction will again result in no endwise movement, but the rubbing speed, previously zero, will now be the difference between the peripheral speeds of the nut and bolt. Internal thread milling might therefore be carried out by replacing the enlarged nut by the work and the bolt by a threaded and gashed cutter. The cutting speed would then clearly be the *difference* between the peripheral speeds of the work and cutter.

In Fig. 2 external thread milling is represented at A and internal milling at B. It will be observed that, if the teeth are to exercise any cutting action at all during internal milling, they must point in the direction opposite to that in which they point during external milling. If, however, as shown at C, facilities exist for reversing the direction of rotation both of the cutter and the work, the cutter teeth need not be reversed in direction. This consideration opens up the possibility of employing the same cutter on internal work as on external. There is, however, an objection to this procedure. If the external and internal work are of the same diameter the use of the same cutter will of necessity involve a lower cutting speed on the internal than on the external work, since in the one case the cutting speed is the difference and in the other the sum of the work and cutter peripheral speeds. To obtain equality in the cutting speeds the number of turns per minute made by the cutter and work during internal milling must be greater, in some cases considerably greater, than the number of turns which they make during external milling.

There is a means of escape from this practical objection. It consists of employing on internal work a cutter with a left-handed thread and of rotating the cutter and work in opposite directions, but at the same number of turns per minute. The thread cut under these conditions will be a right-handed one and the cutting speed will, as on external work, be equal to the *sum* of the peripheral speeds. This system is that which is now adopted under the Richards process.

The Richards system of thread milling, in its primitive form, is open to an objection which does not apply to the older system. In both the thread is cut in a succession of cycloidal bites and not continuously, as it is in a lathe with a single-point tool. The thread, in fact, is a series of convex facets separated by ridges. In the older process the facets are very numerous and very small. Their number, and consequently their size, is determined by the number of gashes in the cutter and the ratio of the speed of the cutter to the speed of the work. As the speed ratio is high the facets are almost undetectable. They may number anything from about a thousand to over eight thousand per thread. In the Richards process the speed ratio is of necessity unity and therefore the number of facets becomes equal to the number of gashes in the cutter or, say, from eight to perhaps three dozen.

Various methods of overcoming the difficulty caused by the facets were tried by Mr. Richards and his associates in the earlier days of the process. One such method consisted of employing a multiple-start cutter with the teeth gashes at other than regular intervals. With a two-start cutter the work is run twice as fast as the cutter. The thread cut on the work is therefore a single-start thread. If the gashes over the second half of the cutter are not diametrically opposite the gashes over the first half two series of overlapping facets will be formed and therefore the number of facets per thread will be doubled. This method did not permit the number of facets to be increased more than, say, four or six times and did not find much favour. A second method described in our issue of October 3rd, 1919, was based on the use of a creep gear in the drive to the cutter. By means of this gear the driving worm crept forward and backward on its shaft through ⅛in. something over twenty-five times per turn of the cutter. As a consequence the rotary speed of the cutter was at times slightly greater and at times slightly less than the rotary speed of the work. This interference with the speed of the cutter gave a great increase in the number of the facets produced on the work and did not greatly affect the pitch or section of the thread cut on the work.

In 1926 Mr. R. J. McLeod, managing director of the Power Plant Company, Ltd., West Drayton, Middlesex, acquired, on behalf of his company, the manufacturing rights of the Richards patents and undertook to find an improved method of overcoming the difficulty created by the facets. Mr. McLeod's solution of the problem is embodied in the machine illustrated herewith, a large machine recently produced at the company's works to the order of Stewarts and Lloyds, Ltd., for thread milling tubes and sockets from 4in. to 11in. in diameter, as used in the oil fields. The screwed joints of these tubes are required to withstand a gas pressure of 2500 lb. to 3000 lb. per square inch without the use of any jointing material. This exacting condition necessitates great accuracy in the threads.

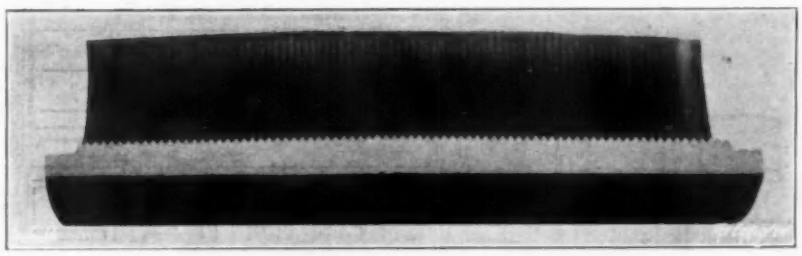


FIG. 3—DOUBLY TAPERED SOCKET WITH CONTINUOUS THREAD

If the cutter has thirty gashes and if the cutter and work make the same number of turns per minute, then at the second turn of the work and cutter each gash will register with the same point on the circumference of the work as that with which it registered on the first turn. Each thread cut on the work would therefore show thirty facets. If the work were 8in. in diameter, each facet would measure 0·838in. from ridge to ridge. Let it be supposed that the cutter is set to rotate very slightly faster than the work, say, 301 turns of the cutter to 300 turns of the work. Then at the end of 300 turns of the work each cutting edge of the cutter will have engaged the work at 301 different points, and as a result the number of facets per thread will, it is argued, be increased from 30 to 30 × 301 or 9030. In practice, we are informed, it is found that an increase in the speed of the cutter in the ratio of 201 to

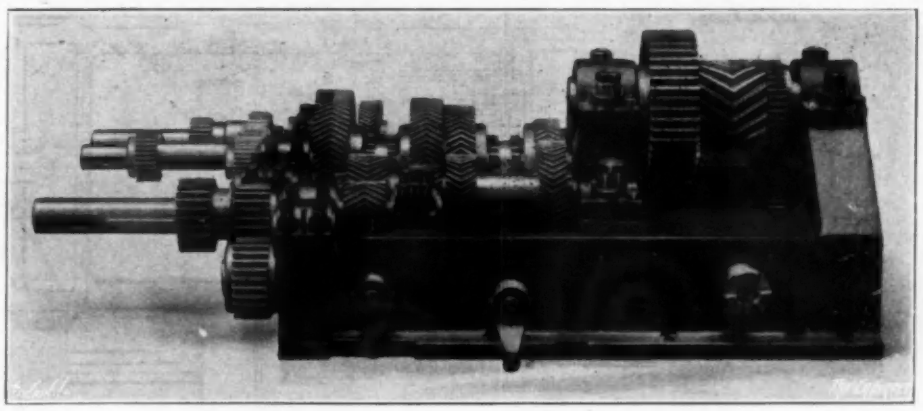


FIG. 4—GEAR BOX

200 is sufficient to give a thread equal to that produced in a screw-cutting lathe, and that if the speed ratio is made 1001 to 1000, the finish on the thread is of mirror-like appearance. With a 301 : 300 speed ratio, the facets on work 8in. in diameter would, it is calculated, measure only 0·00278in. from ridge to ridge.*

This principle is the basis of the McLeod's improvement. It obviously, however, introduces a complication. If the cutter makes 301 turns while the work is making 300 turns, and if there is no relative longitudinal movement between the cutter and the work, then when the work has completed 300 turns the cutter will be leading by one thread, and during the acquisition of this lead, it will have stripped or damaged the thread on the work. Under Mr. McLeod's method the thread is, to begin with, cut with the work and cutter running at equal speed. After the thread has been cut to the full depth, the facets are eliminated by slightly speeding up the cutter and at the same time giving it a slight axial movement to compensate for the stripping effect which would otherwise be present.

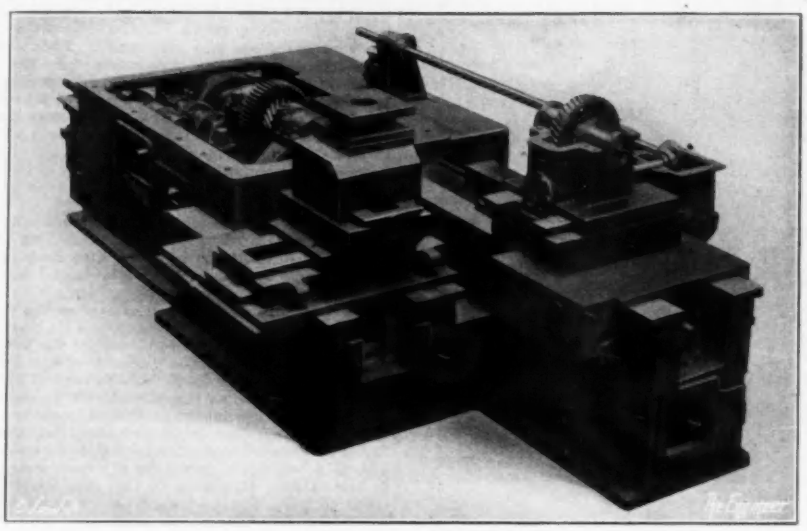


FIG. 5—BED AND SADDLES

During his study of the problem of eliminating the facets, Mr. McLeod discovered that by making certain other additions to the original Richards design it was possible to secure automatically the starting and finishing of a thread in exactly the same positions on identical parts. With these additions, it has become possible, for example, to screw male and female parts in such a way that when assembled they are in correct relative position to within the width of a fine line. Similarly, a doubly tapered socket or coupler, as used on pipe lines, can be screwed half from one end and then half from the other, in such a way that the two threads will meet exactly at the centre and be continuous—see Fig. 3.

The machine illustrated in the accompanying engravings is primarily intended for milling tapered threads externally on the ends of pipes and tapered threads internally on the sockets employed for coupling the pipe lengths together. To that end it is equipped with two saddles, one carrying the thread milling cutter and the other a slide rest with a tool for turning the pipe ends and sockets before they are threaded. Although normally the work is tapered, both saddles can be set for parallel work. In addition, the slide rest is such as to permit a fair range of general turning work to be carried out on the machine.

The headstock, it will be observed, is of exceptional dimensions. Its size has, however, been dictated by the fact that the pipes to be threaded may be as long as 40ft. With one end of such a pipe running free, the load to be supported by the headstock is very considerable. The headstock spindle is hollow, and at each end carries a four-jaw chuck. The rear chuck drives the work, the front one being employed merely to centre it. This arrangement has been adopted as a precaution against the distortion of the threaded end of the pipe.

The machine is driven by a 25 B.H.P. variable-speed motor, which is connected to the first shaft of a gear-box by means of a McLeod "carrier ring" flexible coupling. The gear-box—Fig. 4—is assembled as a separate unit, and, as shown in Fig. 5, is placed in the bed of the machine beneath the headstock. Four changes of speed are provided by groups of double helical gear wheels, which are constantly in mesh and which can be coupled to their shafts by means of dog clutches. The desired speed is selected through the agency of a gate and lever—A in the general arrangement drawing reproduced in Fig. 6—mounted on the right-hand end of the turning saddle bed. The final drive to the headstock spindle is effected through a helical pinion on a floating shaft—see Fig. 4—to which power is transmitted from the gear-box through straight tooth gear wheels. This arrangement permits the headstock spindle to be adjusted longitudinally in its bearings

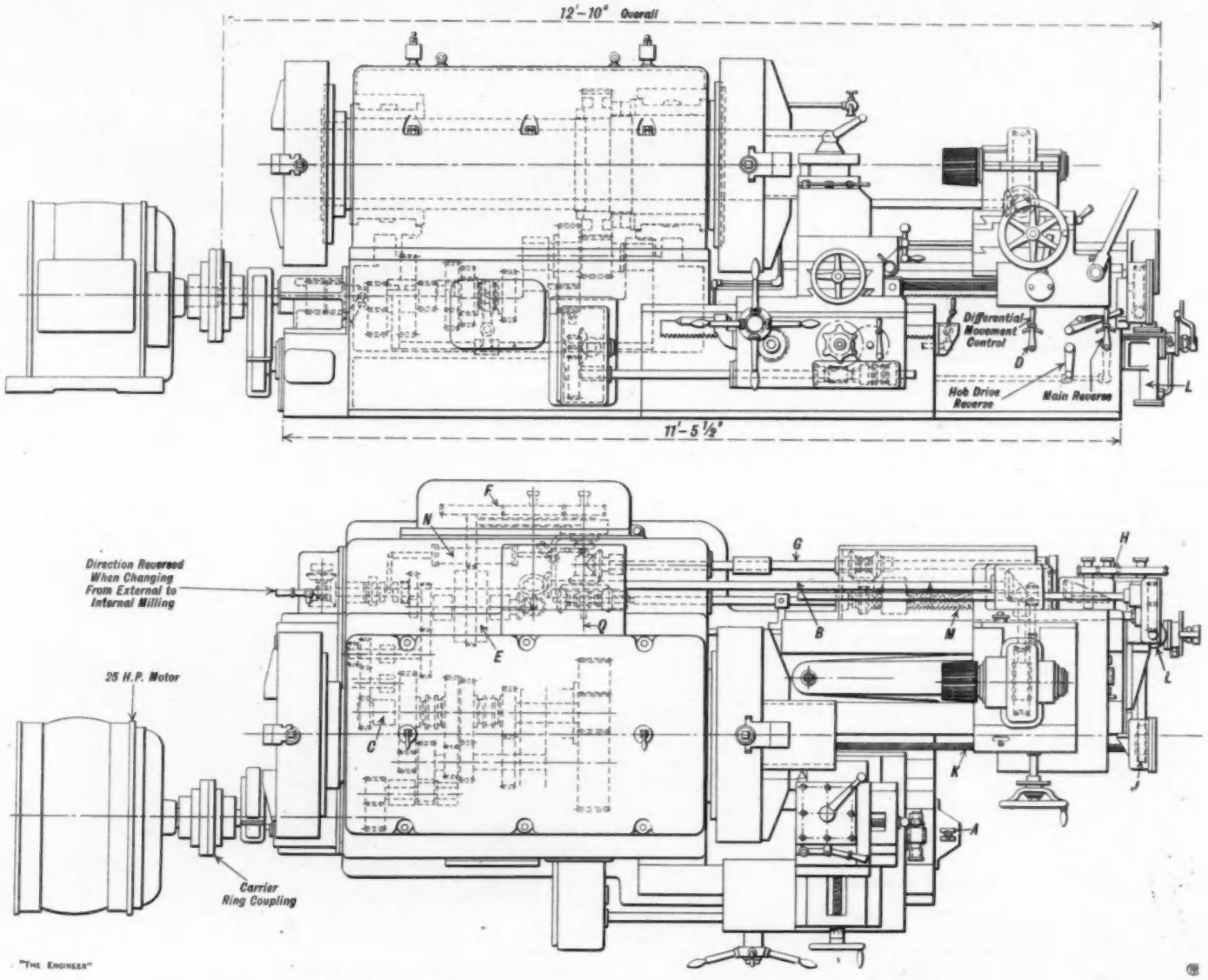


FIG. 6—GENERAL ARRANGEMENT OF MACHINE

* The figures and argument in this paragraph are as given by the makers of the machine. While the principle described undoubtedly greatly increases the number of facets on the thread, we would suggest that the multiplication is not as large as that indicated. The makers' argument is based on the assumption that each cutting face is responsible for a separate series of facets and that there is no coincidence of one series with another. According to our own calculations, a 30-tooth cutter, the speed ratio being 301 : 300, will produce 301 facets per thread. The same cutter with a speed ratio of 201 : 200 will, we estimate, produce more, not fewer, facets, namely, 603 per thread.

rest carries a rotatable holder capable of accommodating four tools.

The milling cutter is driven through worm and bevel gearing from a shaft B—Fig. 6—at the rear of the bed. This shaft is coupled by sundry gearing, with the final driving shaft C in the headstock gear-box, the gear ratio being such that during the preliminary period the cutter and work make the same number of turns per minute. During this preliminary period, as already stated, the thread is cut to the full depth, but facets are formed on it. The removal of these facets is effected subsequently by very slightly speeding up the cutter. This speeding-up movement is controlled from the handle D. Interposed in the drive between the shaft B and the final driving shaft C of the gear-box there is a differential gear E. The outer member of this gear carries the planet wheels, and is

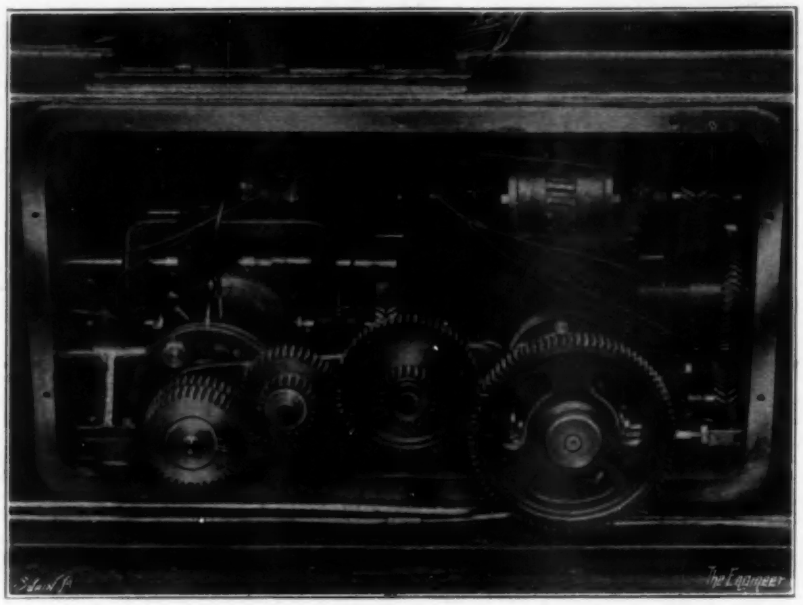


FIG. 7—DIFFERENTIAL GEAR DRIVE FOR CUTTER

surrounded by a worm wheel. During the preliminary period the outer member is stationary, and therefore the drive passes through the differential gear unaffected by it as to speed. When the handle D is operated, a train of spur wheels F—see also Fig. 7—is brought into motion and drives a worm engaging with the worm wheel surrounding the differential gear. The planet wheel member of that gear is thereby caused to rotate, with the result that speed is added to the shaft B and therefore to the cutter, while the speed of the work remains unaltered.

While the facets are being removed in this manner, it is necessary, as we have already explained, to move the cutter longitudinally backwards to compensate for the lead which it would otherwise acquire by virtue of its extra rotary speed. The required motion is derived from the cross shaft Q driving the gear train F. From this cross shaft the motion is transmitted through bevels to a shaft G, and thence through change wheels H and worm gearing J to a lead screw K engaging with a nut on the cutter saddle. The longitudinal movement to be imparted to the saddle is quite small. For example, in the case of work screwed with eight threads per inch it would amount to $\frac{1}{16}$in. during the period occupied by the cutter in advancing one complete turn relatively to the work.

For tapered work the cutter is formed to the required conical shape. It may be noted that the tapered thread which the machine is required to cut is not exactly of the usual pattern. The radial axis of the thread section has to be normal, not to the conical surface of the taper, but to the axis of the pipe or socket. The last two or three threads are required to run out to nothing, not simply as increasingly truncated sections of the fully formed threads preceding them, but as dwarf threads rounded on the crests. The precise form of the thread is determined by the formation of the cutter. So far as the machine is concerned, provision has, however, to be made for the fact that during the removal of the facets from a tapered thread, the cutter must move longitudinally at an inclination to the work axis. This effect is secured by means of a "former" bar in much the same way as adopted for the slide rest.

During the preliminary period when the work and cutter are rotating at equal speed, there is, as we have said, no relative longitudinal movement of the two, but there is a continuous transverse feed of the cutter into the work. This feed extends over a number of revolutions of the work and cutter until the thread, with facets, is cut to the full depth. Hydraulic power is employed to impart the transverse feed to the cutter saddle. The pressure oil is supplied by a small pump driven at constant speed and working against a loaded relief valve. The oil is admitted to a cylinder L at the end of the bed. The piston of this cylinder carries a rack which, through a pair of gear wheels, transmits motion to a horizontal shaft at the rear of the bed, whence it is carried through spiral gearing to a cross shaft beneath the cutter saddle. Pressure can be applied above or below the piston in the cylinder L in order that the saddle may be moved transversely in either direction. During the earlier stages of the cut, the resistance to the feed is less than during the later stages when the cut is approaching the full depth. The hydraulic feed automatically sets itself in accordance with the resistance and is high at the start and decreases towards the end. When the thread reaches the full depth the saddle comes against a dead stop. It is held against that stop by the pressure of oil determined by the setting of the relief valve on the pump. The saddle remains in contact with the dead stop until the finishing or facet-removing process is completed.

During the finishing process the transverse feed of the cutter is stopped in the above described manner, and a longitudinal movement is imparted to it to compensate the "lead" arising from the excess of its speed over that of the work. This compensating movement is, in general, equal to one pitch of the thread being cut and is, therefore, completed when the excess speed of the cutter has caused it to make one complete turn relatively to the work. The speeding up of the cutter and the starting of the longitudinal compensating movement of the cutter saddle are, as already stated, controlled simultaneously from the handle D. Provision is made for tripping the two movements simultaneously and automatically. The longitudinal displacement of the cutter saddle during the finishing process is so small that it would be next to impossible to employ it directly for operating the trip gear. It is, therefore, in effect, magnified.

The magnifying means consists of a short lead screw M, or "repeater," as the makers call it, mounted on the cutter saddle at the rear. This screw is driven by bevel and worm gearing from the shaft G, which shaft, as previously noted, drives the lead screw K, whereby the longitudinal movement is imparted to the cutter saddle. The screw M carries a nut or block which is prevented from rotating. The gear ratios are such that this block moves 8in. for $\frac{1}{2}$in. movement of the cutter saddle. In this way a magnification ratio of 64 to 1 is obtained.

The block is provided with a projecting pin which can engage with two collars on an adjacent horizontal sliding rod—see Fig. 8. When this rod is moved by the pin on the block, one of its ends pushes or pulls into the neutral position the clutch P previously engaged by means of the handle D. The other end of the sliding rod is linked to a five-way hydraulic valve governing the supply of oil to the cylinder L. In this way movement of the sliding rod carrying the collars produces three results. It stops the drive through the train F to the outer member of the differential gear, and therefore restores the cutter speed to equality with that of the work. Secondly, it stops the rotation of the shaft G, and therefore interrupts the longitudinal compensating movement of the cutter saddle. Thirdly, it reverses the action of the oil in the cylinder L, and therefore leads to the withdrawal of the cutter radially from the work.

To reset the machine ready for the next piece of work it is necessary to restore the block on the repeater screw to its starting position. This action is performed semi-automatically. When the handle D goes back into the disengaged position, the operator knows that the finishing process is completed. He thereupon disengages the lead screw nut and racks the cutter saddle backwards clear of the work in order that he may apply a gauge to the thread that has been cut. During this racking movement a tappet gear on the cutter saddle operates a four-way hydraulic valve, and, as a result, pressure oil is admitted to a cylinder N. Two clutches are thereby operated. One of these clutches breaks the drive to the train F, and therefore permits the cross-shaft Q, driving that train during the finishing process, to be rotated without causing the outer member of the differential gear E to be rotated. The second clutch brings into action an alternative, or back, drive to the shaft Q. After he has racked back the cutter saddle, the operator therefore moves the handle D into the reverse position. As a consequence, the clutch P is engaged in the reverse direction, and the alternative drive is coupled to the cross Q shaft, and therefore to the shaft G. From the shaft G the alternative drive is transmitted to the repeater screw and restores the block to its starting position. The alternative drive is not transmitted through the train F, and therefore the cutter position angularly with respect to the work spindle is not altered. That angular position, since the cutter has made just one complete turn relatively to the work during the finishing process, is clearly identical with the position occupied by the cutter relatively to the work spindle at the start of the preliminary process. The alternative drive is transmitted from the shaft G through the change wheels H to the lead screw K, but, because the nut has been disengaged from this screw the alternative drive does not move the cutter saddle. When the block on the repeater screw is restored to its correct starting position, the projecting pin upon it makes contact with the second collar on the sliding shaft. The clutch P is thereupon moved automatically into the neutral position and the shafts Q and G cease to receive the alternative drive. The cutter saddle is now racked forward against a dead stop. During this movement the four-way valve reverses the action of the oil in the cylinder N. Hence, by the time the cutter saddle is brought up against the dead stop the alternative drive has been interrupted, the direct drive restored and the train F recoupled to the shaft Q ready to come into action when the handle D is again operated at the start of the succeeding finishing process. In addition, the block on the repeater screw has been restored to its starting position and the cutter, both radially and longitudinally, occupies the same position relatively to the work spindle as that which it had at the start of operations on the first pipe or coupler. The fact that the initial position radially and longitudinally of the cutter relatively to the work spindle is restored secures the result already mentioned that, on this machine, it is possible to screw successive similar parts in such a way that the thread shall start and finish at the same points on the successive surfaces.

The same consideration makes it possible to produce doubly tapered sockets with the thread continuous from end to end as shown in Fig. 3. The production of these sockets is carried out as follows:—An unthreaded tapered

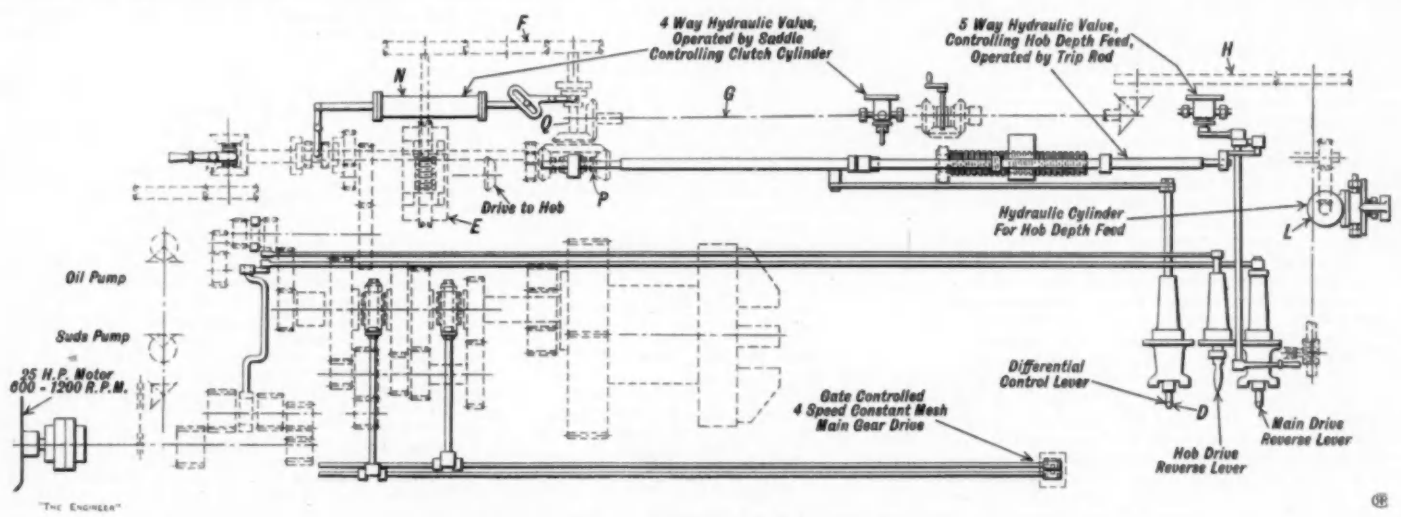


FIG. 8—HYDRAULIC AND MECHANICAL CONTROL DETAILS

nose is secured in the bore of the chuck and a socket machined to size is pushed home on it and secured by the chuck jaws. A tapered thread is thus milled on the socket to extend a little beyond the junction of the tapers at the middle of the socket length. When the required number of sockets have been half-threaded in this manner, the plain tapered nose is replaced by a threaded tapered nose. The cutter is brought up to the nose and the position of its threads relatively to those on the nose is examined by means of a pitch gauge. If, when the cutter saddle is engaged with the lead screw, the two threads are not in agreement, the saddle change wheels are removed and the lead screw is turned until correct engagement is secured. The change wheels are then replaced and the saddle stops are adjusted in position. A half-finished socket can now be screwed on to the taper-threaded nose and gripped by the chuck jaws. If the stops are set in such a way that the second portion of the thread overlaps the first portion the two portions will join up without a discontinuity, and, so long as the threaded nose and the general setting of the machine are not disturbed, all subsequent sockets will similarly have a continuous thread.

The machine, it will be observed, is supplied with a liberal number of reversing gears. These gears, as may be gathered from our preliminary remarks, are rendered necessary by reason of the reversal in the direction of rotation of various elements required in passing from external to internal thread milling. Although the machine has been produced specially for threading pipes and sockets, the system on which it operates is, it is claimed, equally applicable for any other form of external or internal work. It is believed that its accuracy and speed of production are such that it may displace die head and other forms of screwing machines. The design, we are informed, is fully covered by patents in Mr. McLeod's name and in that of the Richards Thread Milling Machine Company (1918), Ltd.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

MODERN CONCRETE.

Sir,—Those of us who would like to see the quality of concrete as generally made for commercial purposes improved to keep step with the increasing number of uses to which it can be put, are beginning to feel that our advance is not quite as rapid as might be.

The position to-day may be defined as follows:—We are using as a general thing aggregate which is described as "washed." It may or may not be entirely clean and the washing is often done with dirty water, but the sand and aggregate are sharp and clean to cursory inspection at least. Our proportioning is rough and ready; we ask for 1 : 2 : 4 or 1 : 1 : 2, or whatever ratio comes into our heads, as being appropriate for the work in hand; nothing is, as a rule, said about proportioning to suit the voids contained in any particular aggregate.

Our mixing is done mainly by machine, though a good deal of hand work is still carried on on small jobs. The concrete is wetted with an amount of water which varies with the whim of the foreman or engineer in charge and with the method of laying adopted. That is our typical procedure; it may be seen in any part of this country.

The results are, as a rule, considered to be "good." A material is obtained which is described as "strong" or "sound"; very often it gives us no trouble and seems likely to endure. Very often, but not always. There are exceptions, and they are numerous enough to be unpleasantly obvious.

A flat roof of concrete is usually considered to require a coating of some bituminous material to render it water and damp-tight. Concrete roads are broken up by the traffic sooner or later. Concrete slabs of quite moderate size have a nasty habit of cracking. Chemicals have to be added to render concrete water-tight. Many designs for concrete works are definitely heavier than they need be; the designer is "taking no chances." But if he knows his material as he ought, there should be no chances to take.

Now, what we wish to know is whether we can do anything to improve these matters without increasing the cost of the work. It is thought that we can, and so far from increasing the cost, we may be able to decrease it, at the same time improving the concrete to a very appreciable extent. Of course, these matters have been thrashed out before; they have been gone into by practical men and by the scientist, but somehow the results of their labours do not seem to be incorporated in our work. We have a great deal of knowledge, but do we use it?

Take the question of clean material. A great deal of our sand and aggregate is washed in a perfunctory way or even not washed at all. Nearly all of it is washed in dirty water. The results are difficult to trace. This, it is felt, is the reason why semi-clean material continues to be used. Failures, leaks, cracks, &c., may only be partially due to dirty aggregate; it is hard to apportion the blame. The quality of the impurity is important. Tests prove that a sand with only 0·5 per cent.—one part in 200—of vegetable matter produced a cement which had only one-third the strength of mortar made with clean sand.

Impurities consisting of clay or loam have very varying effects. One important authority tells us that a proportion—a small proportion, be it understood—of hard clay is not harmful as long as it is not dissolved and smeared over the aggregate and sand. But it is ten to one that during the washing of the aggregate or the mixing of the concrete this clay becomes a film which is spread over the surface of the aggregate and which will prevent adhesion. I was recently informed by an expert in the production of concrete aggregates that in his view nine-tenths of the cracking which takes place in large concrete slabs is due to the presence of dirty aggregate; and slabs of very large size, made from clean and unclean ballast, were shown which certainly appeared to bear out this view. It is fairly clear, at all events, that many of the troubles experienced in obtaining sound and waterproof work would be avoided if the aggregate were perfectly clean.

An inspection of an average washing plant is instructive. Very often the aggregate is washed in or dredged from water carrying large quantities of dirt in suspension, and that dirt subsequently dries on the aggregate and forms a film, preventing adhesion and causing lack of strength, leaks, and cracking.

Many plants suffer from a lack of clean water, others from poor design or careless operation. The remedy is obvious, and I cannot see why clean ballast should not be produced at the same price as alleged "washed" ballast if this is insisted on.

So much for washing. Then comes that all-important matter, the question of grading. How little that is appreciated even to-day may be judged from the fact that an engineer in charge of coast defence works once told me that the best material for foreshore concrete groin construction consisted of aggregate in which "all the stones were the same size." Many engineers will say that that story is incredible, but are they in a position to fling the first stone—or handful of aggregate? I do not think that they are. On my table lie a number of specifications emanating from the highest quarters. They specify concrete as of 1 : 2 : 4. The aggregate is described as being "clean and well-graded."

Now, I do not propose to enter into a discussion of a matter which has been thrashed out time and again, but it seems extraordinary that such specifications should be issued without any reference to the matter of grading by void determination. The cost is not more; it is less. Once the voids are determined and precise proportioning is based thereon, the quantity of cement may be reduced and the work be stronger than when working blindly and by rule of thumb.

What does "well-graded" mean? Why not ask for what is wanted and avoid generalities? If an aggregate with voids of not more than, say, 27 per cent. are required, why not ask for it? You then know what you are getting, and, moreover, you know the amount of sand to add. An error of 10 per cent. in the correct admixture of sand will produce, in average material, an increase of between 2 and 3 per cent. in voids throughout the whole mass; and is it thought that sand is proportioned—by the 1 : 2 : 4 method—as near as 10 per cent.?

No, it is felt that we are not making the best use of our materials; we are working by rule of thumb and eye, and until the use of volumetric synthesis and mechanical analysis become the rule on works we shall never realise what wonderful stuff concrete really is, and how our fears of damp, leakages, cracks, &c., can be forgotten if we care to use a little very simple science. I at least would not care to undertake any concrete work unless provided with the few simple tools which would enable me to see what materials I was using and how best to handle them.

It is believed, too, that if specifications were drawn up so that the strength, permeability and other qualities of the concrete were stated rather than the proportion of materials to be used, lower prices and better work would be the result. At present, however, no contractor who wished to calculate his own proportioning would be allowed to do so, even if he guaranteed concrete of a certain strength and at a reduced price. Such a proposal might not be considered practicable, but there is no reason why the Authority concerned should not do a little analysis and give us something more scientific than "clean-graded ballast and sand, mixed at the ratio of 1 : 2 : 4." Public money would be saved and better work done. As long as twenty years ago that expert on all matters relating to concrete, Mr. W. B. Fuller, wrote:—"By careful grading the materials by methods of mechanical analysis the writer has obtained water-tight work with a mixture of 1 : 3 : 7." And one must consider that the cement used by Mr. Fuller was probably not equal in quality to that available to-day.

Is it possible to obtain a like result with the unanalysed materials now in use, even though a much larger proportion of cement is employed? I take leave to doubt it.

To sum up, then:—

(1) Clean aggregate will make better concrete than semi-clean without putting up the cost.

(2) When aggregate composed of specified percentages of a number of sizes of stone is employed, care should be taken that the specification really does ensure the densest possible mix. That should be determined by analysis.

(3) When aggregate composed of mixed unknown sizes is employed—such as Thames ballast—the voids should be determined before the proportion of sand to be added is specified.

(4) Correct proportions of water should be added in mixing, and this matter should not be left to the foibles of a driver or a navvy ganger.

(5) Finally, the strength and type of concrete is the matter to be considered, not the proportioning. Once we know what is wanted the means of obtaining it at the least possible outlay can be settled.

October 26th. Concrete.

WASTE.

Sir,—It is useful to review briefly the progress in social well-being during the last few hundred years, to see how far the harnessed forces of Nature have actually been of service to man. Mr. J. L. Hodgson, in your issue of the 2nd inst., is to be commended on the excellent way he presented the facts, distressing though they be.

According to the information gleaned by Mr. Hodgson, a peasant in Tudor times, lacking everything presumably but the most primitive tools, was able to support himself and his family by working only fifteen weeks in the year! Most of us, in spite of productive capacity being increased by more than a hundredfold, have to work nearly fifty weeks in the year, and it is fairly safe to say that at the end of that time our material security is much more precarious than it was in those days. What a commentary on the real progress made!

It is my conviction that the root cause of this social inefficiency is due to a fundamental flaw in our financial system. An excellent, brief, yet conclusive, proof of this will be found in the letter from Major C. H. Douglas, published by you in The Engineer on April 24th last, where he shows that the rate of flow of purchasing power distributed in respect of the production of goods and services, must normally be less than the rate of flow of prices. I have only seen one adverse criticism of this letter, from a Mr. Silk of Sydney, Australia, which appeared in your issue of August 14th. This letter, however, is so irrelevant that it shows that the writer cannot properly understand the financial system or the true nature and source of money.

Mr. Silk's curious reaction to a rational and reasoned statement is due to well-known psychological observations that ideas, which have been thoroughly inculcated into an individual from his youth up, become as realities to him. They are firm convictions which no amount of logic will shake. This difficulty was well illustrated by Professor Elliot Smith in his Huxley Memorial Lecture, entitled "Conversion in Science," of a year or so ago. So it is that numbers of so-called "economic laws" are not laws in the sense of laws of Nature, but are really financial conventions. For reasons given, they are held, nevertheless, even by men with a scientific training. Perhaps one of the most pernicious beliefs in this category is the one almost universally held that unbalanced national Budgets lead to disaster. Yet it is safe to say that the balancing of national Budgets is one of the causes of our troubles. Obviously in the case of Great Britain it means the curtailing of money expenditure and economies everywhere. More goods will remain unsold, necessary repairs to plant and machinery will be postponed, and increased waste and deterioration will be manifest. You cannot destroy real credit without eventually destroying financial credit. We are indeed asked to restore our financial credit at the expense of our real credit, and a little reflection will show that this must lead to ultimate disaster. Such are the dilemmas to which "sound finance" always lead us.

It is the engineer who has made the Age of Leisure a practicable possibility now, and it is the financier, probably imbued by the highest motives, who is making the world into a series of Pauper States. Paradoxically, he is backed in his methods by millions of decent law-abiding people, who feel that sacrifices must be made because we have been in some obscure way breaking "laws of Nature."

The growing armies of unemployed, and therefore more or less destitute people, are more and more restless, and the chances of riots and revolutions are rapidly increasing. Nations, rather than tolerate internal revolutions, will prefer war, and that is a greater probability in the world to-day than it has been since 1914. There is just the chance of an alternative in the creation of Work States. In either case, it will mean more millions regimented and committed to drudgery, so that the chances of culture and enlightenment which are only completely possible in a Leisure State are lost.

The greatest engineering problem of the day is finance. Let the engineer apply his methods to finance, and the waste of to-day will soon become a thing of the past.

R. Gaudin.

London, W. 2., October 20th.

A LARGE ARCH DAM.

The latest addition to the many large modern dams in the United States is the Tujunga Dam for flood protection of the city of Los Angeles. It is an arch dam of variable radius, with a maximum height of 240ft., and having abutments of the gravity type. It will regulate the flow from a drainage area of 100 square miles, and its waste weir or spillway, formed in one of the abutments, is designed to carry a run-off of 400 cubic feet per second per square mile of the drainage area. The arch is 400ft. long on the crest, which is 8ft. thick and has a radius of 190ft. At the base, the radius is 120ft. and the thickness 75ft. The site is in a good rock formation, which was explored by drill holes. A deep trench was made in the rock for a cut-off wall, and in the base of this holes 150ft. deep were drilled at intervals of 20ft. These were then grouted to refusal under pressure of 100 lb. The concrete was carried up in blocks 50ft. wide, with radial joints. Grouting pipes were placed in these joints, which were made water-tight by copper plates at a foot from both the upstream face and the downstream face. Provision is made for measuring temperatures and stresses within the dam, when it is under load, electric thermometers and strain gauges being embedded in the concrete and connected to recording apparatus. This practice is followed on an elaborate scale in many recent concrete dams. Two outlets of 62in. diameter are provided, and three openings are fitted with 60 m. needle valves. All these openings have vertically sliding gates operated by hydraulic cylinders, and controlled from a valve-house. Concrete mixed in a 2-yard drum was carried by a travelling belt to the buckets of a hoisting tower, from which it was distributed by inclined chutes or troughs and vertical telescopic drop pipes fed by the chutes.

Railway and Road Matters.

The railwaymen's unions officially supported eighteen candidates in the recent General Election and unofficially backed eleven. Not one of the twenty-nine has been elected. Moreover, six of the National Union official candidates and three of the unofficial were in the previous Parliament, whilst all eight of the Railway Clerks' Association official candidates were Members. Thus, all the eighteen railwaymen are missing. Mr. J. H. Thomas, of course, remains, but he was disowned by his union.

Now that it has been proved that the addition of a sand drag will pull up wagons that have run back down inclines, and been intercepted by runaway catchpoints, it is clear that considerable damage to rolling stock could under such conditions often be avoided. For instance, thirty-six wagons and their brake van broke loose on October 16th, when running between Miller's Dale and Peak Forest, and seven wagons and the van were totally destroyed and their contents spread over both main lines.

The users of motor cars who have in view a business or holiday tour have been able, provided there were two passengers, to send their cars by rail for part of the distance —*e.g.*, through congested areas—at a rate of 3d. per mile, additional to their own railway fares for the same distance. At the Railway Rates Tribunal on October 20th approval was given to this rate, being 3d. per mile for the outward journey and 1½d. per mile for the return. The chairman, in announcing the approval of the Tribunal, said that he had used the facilities and had found it of very great advantage to be able to send his motor car by train.

In our issue of October 23rd we quoted from the *London and North-Eastern Railway Magazine* as to the use of inclined guides for placing rails in position with considerably less labour. Another device therein described was a portable mechanical stone ballast riddle, designed by Mr. H. Hills and Mr. W. J. Naisbitt. It consists of an inclined riddle which is vibrated by means of a small petrol engine. The cleaning of stone ballast can be carried out with greater speed and efficiency by this means than by the ordinary method of using ballast forks. Although the machine is light and compact, it can riddle ballast at a rate which keeps seven men fully employed in handling the material.

The Ministry of Transport railway statistics for July have recently been published as a Stationery Office publication, price 2s. 6d. They show that, compared with July, 1930, there was a reduction of 3·3 per cent. in the number of passenger journeys made, and of 4·2 per cent. in the receipts from passengers. The loss was, in part, compensated for by a reduction of 2·7 per cent. in the passenger train mileage. The tonnage of freight traffic fell by 10·7 per cent., and the freight receipts by 9·6 per cent. There was, however, a drop of 5 per cent. in the freight train mileage. The average train load fell from 122¾ to 121¼ tons, but the net ton-miles per engine-hour rose from 447¼ to 449¼, *i.e.*, the traffic moved more quickly.

The area between Poppleton Junction, York, and Northallerton, which, as related in this column on October 9th, is to be equipped with automatic signalling, power signalling, and all the latest developments of that art, includes the 11 miles between Alne and Thirsk, which were provided with automatic signals in 1904. The section then chosen was an admirable one for testing the claim that automatic signalling increased the carrying capacity of the line. That the claim was justified was indicated by figures published in 1917 which showed that, compared with 1901, the number of train movements had increased by 27 p. c. The length in question lay between two sections of four track and was immediately outside the busy railway centre of York, and not until now has it been considered necessary to widen the line. Some widening is now to be done on the 11-mile length, but it is only between Alne and Pilmoor, 4¼ miles, and is one additional line, available, however, for traffic in both the down and up directions.

On page 11 of our issue of July 3rd last it was mentioned that the railways of the United States were applying to the Interstate Commerce Commission for permission to increase their rates generally by 15 per cent. The application was duly made, and on October 20th was refused. The Commission point out that some of the companies are in a position to maintain their credit, so they suggest that the rates on certain commodities should be increased and a pool be formed out of the result—estimated at from 100 to 125 million dollars—to assist the weaker lines over the depression. The judgment claims that the situation now has in it the element of panic, and contends that the railways are no worse off than other businesses, and that they will share in the ultimate economic recovery. It is believed that President Hoover and the banking interests favour such a pool, and a factor to be remembered is that the railway brotherhoods would fight against any reduction in wages as an alternative. At first the railways were not disposed to accept the suggested pooling, but later advices anticipate their acceptance, on condition that the money taken by the more needy carriers shall be regarded as a loan and not as a gift.

The Board of Trade export tables for the month of September show the value of the railway material sent overseas during the first nine months of the present year to be as follows; the corresponding figures for 1930 and 1929 being added in parenthesis:—Locomotives, £1,382,020 (£2,661,327, £2,359,157); rails, £696,970 (£1,860,297, £2,039,605); carriages, £935,973 (£1,443,187, £1,722,332); wagons, £887,209 (£2,419,704, £1,875,912); wheels and axles, £154,207 (£301,062, £339,397); tires and axles, £230,561 (£498,654, £401,031); chairs and metal sleepers, £293,372 (£539,695, £366,717); miscellaneous permanent way, £346,399 (£657,384, £781,837); total permanent way, £1,756,411 (£3,944,632, £4,045,665). The weight of the rails exported was 83,732 tons (216,135 tons, 243,303 tons) and of the chairs and metal sleepers 38,565 tons (57,128 tons, 35,755 tons). During the month of September last locomotives of the value of £127,213 were shipped, which included:—India, £101,874, and South Africa, £2353. The rails shipped were of the value of £54,929, and included:—British West Africa, £35,223; India, £7228; South Africa, £4915; Argentina, £1449; Portuguese West Africa, £871; and New Zealand, £428.

Notes and Memoranda.

It is estimated that there are 35,603,000 motor vehicles in the world, of which 74·4 per cent. are in the United States. This shows an increase in 1930 of 1·8 per cent. in the world against a falling off in the United States.

A condenser with 101,000 square feet of tube surface has been installed in the Hudson-avenue station of the Brooklyn Edison Company. It weighs about 608 tons and takes the steam from a 160,000 kW turbo-generator.

The Industrial Steel Casting Company, Toledo, Ohio, is reported to be making cast crank shafts and connecting-rods, and claims that results superior to forged shafts have been obtained. A nickel-manganese steel is used and is subjected to a three-stage heat-treatment.

During this year an area of about 7800 square miles in the region east of Great Bear Lake, Canada, was photographed from the air. Other areas have been similarly photographed for the Geological Survey near Noranda, Quebec; Sydney, Nova Scotia; Timagami, Quebec, and on the West Coast of Hudson Bay.

Some experiments carried out by the Forest Products Laboratory of the United States show that the durability of plywood can be greatly increased by a treatment with beta-naphthol in linseed oil, or with creosote, both of which greatly retard the decomposition of the glue itself and protect the wood against the attack of wood-destroying organisms.

According to a contemporary, by way of an experiment fifty-four years ago, a portion of the new wood paving in Beech-street, London, was "charged with iron"—3 cwt. to the square yard. The iron blocks weighed 16 lb. each, were rounded and serrated on the surface for foothold, perforated for grouting material, and imbedded in sand on the ordinary concrete bed. The designer and patentee was Mr. Dennison, a London architect.

Recently, Dr. Jacob Papish, Professor of Spectroscopy at Cornell University, announced that he had identified number 87 of the known atomic elements in the mineral Samarskite. The element, of which Dr. Papish has obtained a spectograph, is an unstable solid. It is stated to occur to the extent of one part in two million. This element would appear to be the missing alkali following cæsium. The radioactive properties of the element, if any, should be interesting.

A new method of laying wood block floors is described in the October issue of the *General Electric Review*. After a thin layer of pitch has been spread over the concrete, wire netting is laid on the pitch and rolled flat so as not to interfere with the laying of the blocks. The blocks are then laid, and by passing current through the wire netting, the pitch is melted and it adheres to the blocks. Finally, the blocks are rolled and the pitch allowed to harden, when a clean floor suitable for the most severe use is said to be produced.

For use in its Crawford-avenue station, the Commonwealth Edison Company of Chicago has placed an order with the Westinghouse Company for what is stated to be the largest synchronous condenser ever made, it being reported that the machine will exceed by 50 per cent. the capacity of any existing synchronous condenser. When installed, the machine, with its auxiliaries, will be 45ft. long and 20ft. wide, and it will weigh 400 tons. The condenser will have a rating of 75,000 kVA. The auxiliaries consist of a directly connected starting motor and high-speed excitation equipment. The purpose of the machine is to provide the voltage and power factor regulation necessary to obtain the maximum capacity of a 220 kV transmission line.

In the course of a lecture recently given in London Mr. J. F. Kayser said that the methods of producing the edge of a safety razor blade varied, but whatever the exact process adopted, it could usually be roughly divided into the following three operations:—(1) Rough-grinding by means of an emery wheel; (2) finish-grinding by means of a fine-grained emery wheel, or by means of hardened and polished steel wheels dressed with a preparation of stearine and chromium sesqui-oxide; and (3) a final stropping process. Some manufacturers put the cutting edge upon individual blanks which had been already hardened and tempered. Other manufacturers, on the other hand, produce the finished edge on long coils of hardened and tempered strip which were finally broken up into safety razor blades.

The Institution of Electrical Engineers has approved an additional clause to paragraph 69 of its Regulations for the Electrical Equipment of Buildings. This states that where a distribution board is combined with a main switch no main fuses will be necessary, provided that the connected lighting load does not exceed 5 ampères and the total connected load is not more than 30 ampères. The distribution board, however, must not comprise more than three double-pole fuse-ways, each rated at not more than 15 ampères, and must be enclosed in a case of metal or non-conducting, non-ignitable and non-hygroscopic material. The latter is only to be used when the case is not liable to mechanical damage. It must also be possible to operate the switch from outside the case. The system now authorised is that which has long been known as the "splitter switch."

An unusual case of pipe corrosion has recently been brought to the notice of the Copper and Brass Extended Uses Council. A large institution put in a service of both hot and cold water pipes in copper about 1910. Till quite recently the installation was satisfactory, but a little while ago the water supply was chlorinated and treated with alumina-ferric. Trouble began to occur in the horizontal lengths of the hot water pipes. The trouble was eventually traced to rust from the iron tanks, settling on the bottom of the horizontal pipes where the flow was slowest, and there, with the help of the treated water, setting up electrolytic corrosion with the copper. The trouble was found to be due to over-alumination of the water, which resulted in an increase of acidity. It has been recommended that the water should be treated with soda-ash in addition to alumina, or by substituting sodium aluminate in place of the alumina.

Miscellanea.

The new Carter Bridge at Lagos, Southern Nigeria, was formally opened on October 22nd. It is 2600ft. long and carries both railway and road traffic. It connects Lagos Island with Iddo Island.

A new picture telegraphy service between Italy and the United States was opened on October 16th *vid* London and over the Transatlantic wireless circuits of Imperial and International Communications, Ltd.

It is intended to expend 500 million roubles on the provision of communal hot water heating services in Moscow between 1932–37. It is suggested that the system will effect a saving of one and a-half million tons of fuel a year.

It is reported that the contracts entered into between British manufacturers and the U.S.S.R. during the period from July 1st to September 30th of this year amounted to £4,581,693. Of this amount nearly one-half was accounted for by machine tools.

According to *Rural Electrification*, Lord Vernon has decided to close down the gasworks in the village of Sudbury in the early spring, as he proposes to supply the whole village with electricity. He has notified all his tenants that their premises will be wired for electricity.

The Safety in Mines Research Board has published a subject index, with title page and table of contents, of Volume VI. of its publications, comprising the eighth annual report and papers Nos. 57 to 63 published in 1930. The index—price 2d.—can be obtained from H.M. Stationery Office.

H.M. Trade Commissioner at Vancouver reports that the City of Edmonton is calling for tenders, to be presented in Edmonton by November 19th, 1931, for the supply of heavy rails, tie plates and spikes for street car systems. Firms desirous of offering materials of United Kingdom manufacture can obtain further particulars of this call for tenders upon application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1. Reference number G.X. 10,866 should be quoted.

The Soviet Ukrainian Government is starting in November the construction of two hydro-electric power stations on the river Boug, near the town of Pervomaysk, formerly called Olviopol. The stations are to be called the Upper Boug State Power Station and the Lower Boug State Power Station, and are to have a capacity of 20,000 and 14,500 kilowatts respectively. The estimated cost of the construction is 38 million roubles. The stations will be surrounded by industries inter-related in requirements; among them a large metallurgical works and a graphite—plumbago—factory. Recent prospecting shows that there are rich deposits of iron ore and manganese in this district.

The Director of the British Engineering Standards Association, Mr. C. le Maistre, is leaving for the Dominions of New Zealand, Australia and Canada at the beginning of November, to further the desire of the Imperial Conference for the close co-ordination of the work of the various standardising bodies throughout the Empire. The desirability of the British standard specifications meeting to the fullest possible extent the requirements of Empire purchasers is fully realised by the Association, and it is hoped that the personal contacts established by this visit of the Director will do much to promote mutual understanding and facilitate such a co-ordination of industrial standard specifications within the Empire as will assist substantially the revival of overseas trade.

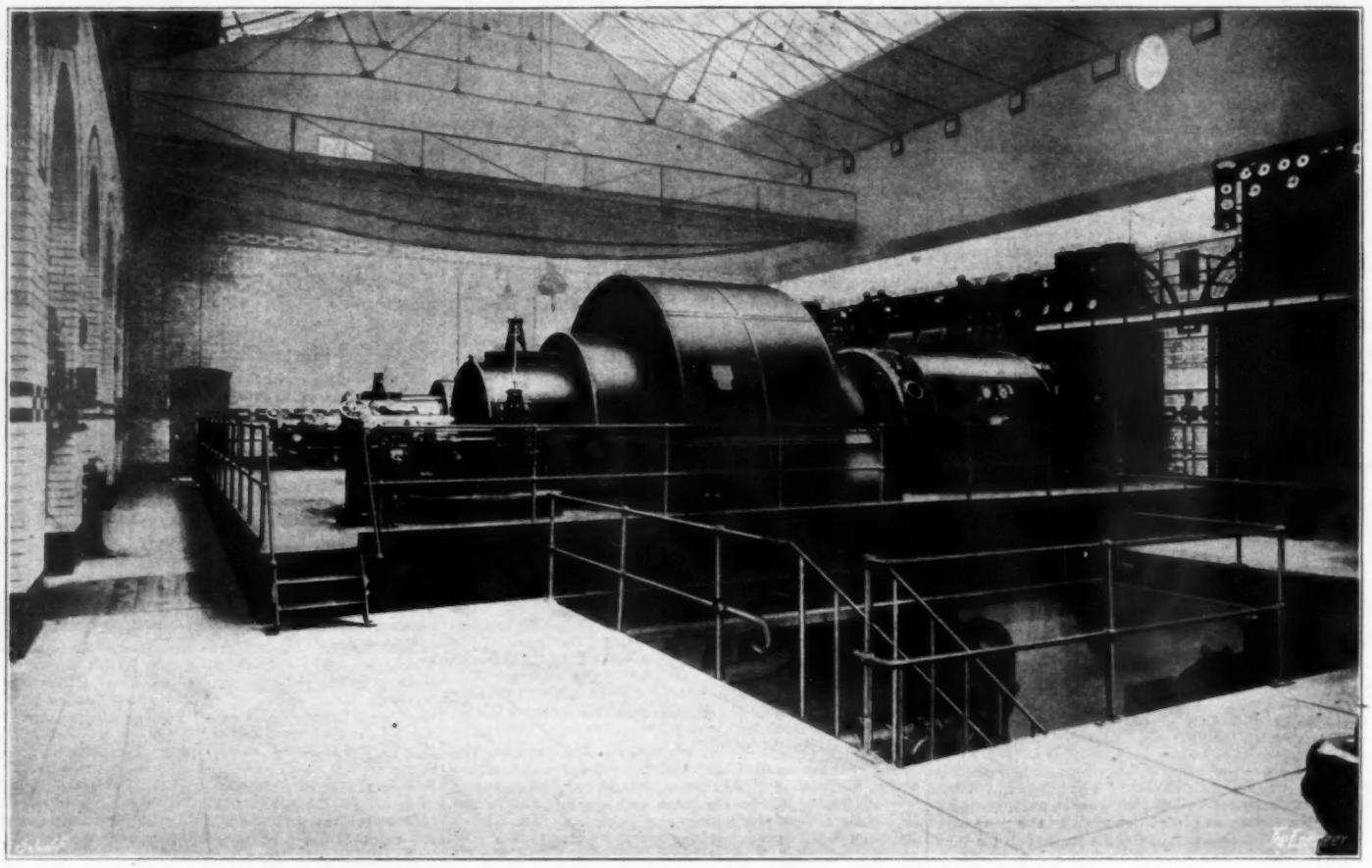
According to the report of the Electrical Inspector to the Government of Madras for the year 1930–31, the total number of towns with an electricity supply now amounts to twenty-one, of which four were electrified during the year. The total generating capacity of all undertakings amounts now to nearly 33,000 kW. There was no noticeable improvement in general in the cost of production, and the average price per kWh paid by the consumer did not alter. A model form of street lighting agreement between licensed undertakings and local authorities was drawn up and is now generally used. The report refers to the electrification of the suburban service of the South Indian Railway. This development is interesting, as it is the first metre gauge electrification in India. The D.C. system working at a pressure of 1500 has been adopted.

According to Dr. R. W. Brock, Dean of the University of British Columbia, who recently conducted a mineral resources survey for the Provincial Government, the Cariboo country still contains gold deposits of great value. Considerable prospecting is now going on in the area, and intensive development and modern methods of production are expected to give results far surpassing the records of a half century ago. The Cariboo country lies to the south and east of Prince George, being bounded on the west and north-east by the Fraser River and on the south-east by the North Thompson River. Placer deposits along the Fraser, Thompson and other rivers are being worked and are yielding good results, and many old diggings are being re-worked. New roads, which the British Columbia Government intends to construct in close proximity to the area, are expected to stimulate prospecting by making access to the remote streams of the Cariboo Mountains more convenient.

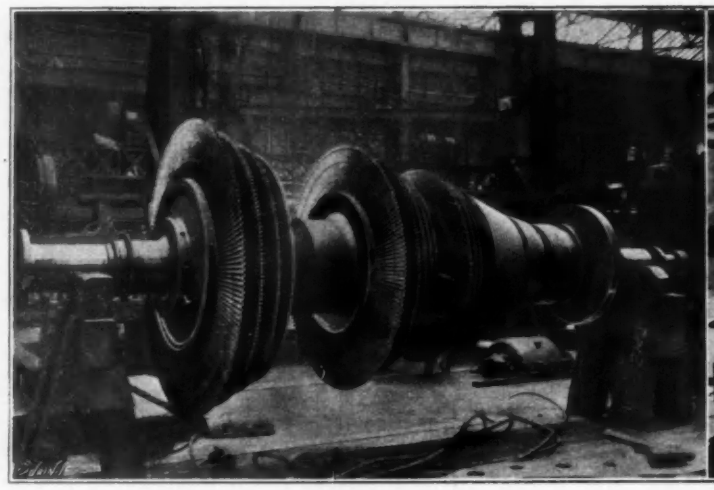
Parts of two 42,000 kW turbo-generator sets which have been built by the Metropolitan-Vickers Electrical Company for the Rotterdam Municipality have recently been sent to their destination. The order was secured against severe continental competition, which is a striking testimony to the skill of British engineers. As the aggregate weight of the two sets is about 900 tons, their transport to the site has presented interesting problems. Although the power station at Rotterdam is only a few hundred yards away from the quay, it has been necessary to procure a special truck from Krupps, of Germany, to carry the alternator stators, each of which weigh about 70 tons. The turbines are of the two-cylinder type, and they are to operate with steam at 365 lb. per square inch superheated to 752 deg. Fah. The alternators are designed to give their rated output at 0·875 power factor, and are wound for 5500/5800 volts. The condensers, evaporators, feed heaters and auxiliaries have also been made by the Metropolitan-Vickers Electrical Company.

A 20,000-kW DUPLEX-EXHAUST STEAM TURBINE

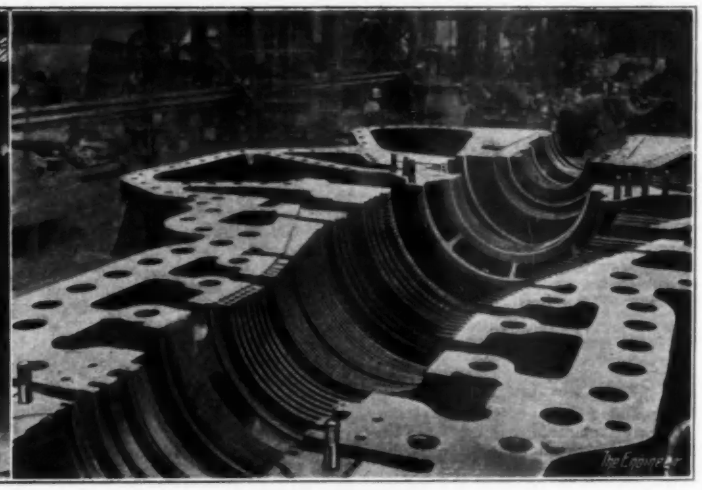
(*For description see page 468.*)



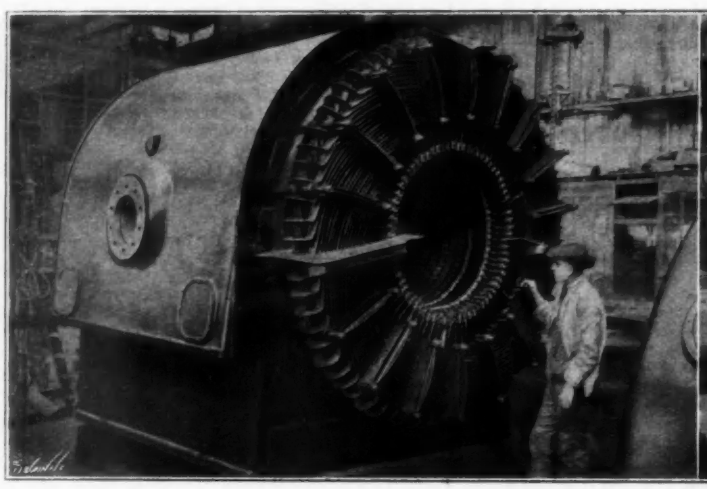
EXTERNAL APPEARANCE OF 20,000-kW DUPLEX-EXHAUST STEAM TURBINE



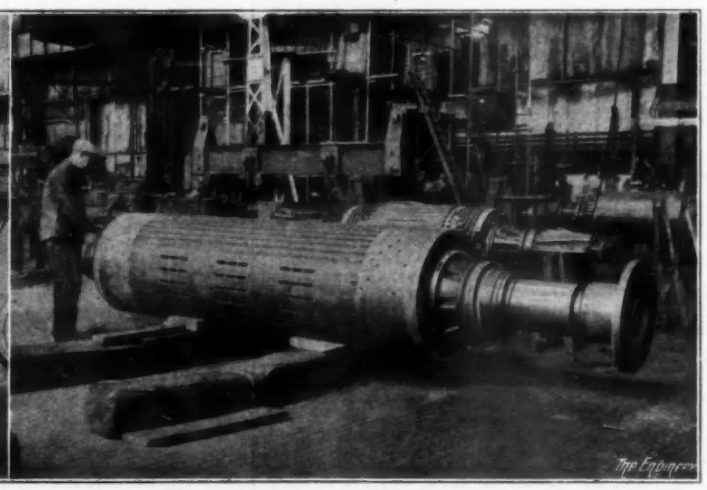
TURBINE ROTOR



LOWER PART OF CASING



STATOR OF ALTERNATOR



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SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

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The Metallurgist.

THE OCTOBER NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

VOL. CLII. No. 3955

OCTOBER 30, 1931.

The General Election.

A FEW weeks ago we asked engineers to clear their minds of party feelings when they went to the poll, and to cast their votes for those candidates who were on the side of the National Government. The astounding and unprecedented result of the General Election leaves no room for doubt that they, in all classes of life, have followed that course. It is true that in Wales and Scotland a few Socialists have succeeded in retaining their seats, but practically the whole of industrial England and Northern Ireland has shown itself solid, as the word goes, for a return to a temperate and stable policy and for the introduction or development of economic principles which will be beneficial to the trade of the whole kingdom and, ultimately, of the Empire and the world. The fact that, in round numbers, two-thirds of all the electors have expressed by their votes their desire for the relinquishment of Socialism and its replacement by a sound conservative economic system cannot fail to impress every intelligent nation of the two hemispheres with the resolution of Great Britain to set her house in order, to restore her financial position, to put an end to madcap extravagance, and to regain the respect and admiration which once were universally rendered to her. Upon the work of the new Government the eyes of all nations will be centred. With a nine-fold majority it finds itself in the position of an autocrat. But that need give us no cause for anxiety; rather for rejoicing. A weak Government is forced to follow the mean line between two policies; a strong one can, without fear, take that which it holds to be the best. That the National Government will adopt those courses which the needs of the country demand is in no doubt, and we are confident that in a few weeks we shall see necessary reforms initiated and the beginnings of a return to courses which will ensure a revival of industries. It has been said by some economists that the United Kingdom is not guiltless in the matter of the trade depression which has overtaken the world. Whether that be true or not, we are profoundly confident that the overthrow of an irresponsible and narrow policy and its replacement by one which exhibits true statesmanship and a proper recognition and evaluation of the economic effects which follow causes as day the night, must ere long bring about, not only a National, not only an Imperial, but a world-wide improvement in every kind of industry and thereby in the social condition and welfare of mankind. In rejoicing in the prospect foreshadowed by the establishment of a strong moderate Government we look forward with the liveliest expectations to the effect which it must inevitably have upon the industry to which we are devoted. Though some things may have to be done of which all engineers cannot approve, we accept their action in the election as abundant proof that they will continue to subject their own wishes and their own immediate advantages to the common welfare, confident that thereby they will in the long run rebuild the commerce and industries of Great Britain.

Friends of the Tank.

OF all the industries which have suffered under the depression of the past few years, none has been more severely hit than that of shipbuilding. Unemployment has reached the enormous figure of 60 per cent., and the tonnage output has fallen from the once attainable figure of three million tons per annum to little more than one million tons. In part, this unprecedented "slump" is no more than a reflection of over-capacity, and a correction is being made by the deletion of redundant yards, but when all due allowance is made for that cause, the state of the industry is very bad. Orders have been few and far between and shipbuilders have not been in a position to carry out improvements and developments which the demands of progress require. Shipowning has suffered at least as much as shipbuilding, and our greater and lesser ports and harbours have been littered with vessels lying idle for lack of freights. In such circumstances, the reluctance of these associated industries to give financial support to the National Experimental Tank at Teddington would be comprehensible were not the sum involved so small that even in the hardest times its incidence would be scarcely appreciable. The annual cost of operating the tank and laboratory is, in round figures, £12,000. They earn in fees about £7000 a year, leaving an adverse balance of £5000. Following its customary practice, the Department of Scientific and Industrial Research has up to now given pound for pound to all sums contributed by the industry for research, and with this assistance the sum required from shipbuilders and shipowners is the quite insignificant amount of £2500. With an increase in subscriptions no greater than that, the anxiety as to the possibility of continuing research in the laboratories would be removed.

When we reflect upon the fact that a contribution of £50 per annum from each of fifty owners and builders would meet the deficit—a sum which they would have no hesitation in spending upon an extra office-boy or the re-decoration of the board room—we are forced to the conclusion that nothing less than a lack of faith in the value of shipbuilding research, or a belief that it is solely the business of the Government, can account for the poor support which is given to the National Tanks at Teddington. That attitude is not without its parallel in other depressed industries. Possibly one may regard it as a reflection of the old-time "practical" spirit of British industrialists, many of whom even to this day look askance upon scientific research, believing that advances are more readily brought about by secular advances in design or operation than by laboratory investigations. It is said sometimes by shipbuilders that no experimental tank is as good as the deep sea. On the other hand, there are many who regularly submit their problems to the tank, and would not think of beginning the construction and equipment of a new vessel until they had assured themselves by model tests that the proposed form was the best attainable in the present state of our knowledge. The fact that £7000 a year is paid to the William Froude Laboratory alone for experiments and advice is a clear indication of the confidence of many builders and owners in model investigations.

In four years 188 designs were submitted for examination, and in no less than 114 some improvement was effected, in eleven cases the efficiency was augmented by between 20 and 30 per cent., in twenty-two cases between 10 and 20 per cent., and in forty-seven cases between 3 and 10 per cent. These are very suggestive figures. It may be said that so much is now known about design that the monetary value of research is diminishing. An analysis of the returns for the four years 1927-1930 gives but little support to that view. Let us put the figures side by side. First the number "tested" and then the number "improved." The pairs for the successive years were as follows:—48–25, 59–34, 51–30, 30–25. It will be seen that, speaking broadly, improvement was effected in 50 per cent. of the cases. There is, perhaps, some indication that the degree of improvement tends, as one might reasonably expect, to grow less. But it is not very clear, and, as a matter of fact, out of the thirty tests of 1930 no less than five brought about an increase in efficiency between 20 and 30 per cent. In face of these facts we do not think any doubt can remain about the value of these researches to the shipping industry. Their national value is also considerable, for by the economy of fuel alone an expenditure of £105,000, on the basis of oil at £3 10s. per ton, results annually from the improvements effected in the four years taken for analysis.

If any further argument were required, we might turn to foreign activities. We might point out that in Germany the Hamburg and Berlin tanks have been and are being improved at the cost of many thousand pounds; that at Spezia £12,000 has been spent, and at Rome a new tank has been completed; that Holland is just bringing to completion a tank, longer than the Yarrow tank, which has cost £60,000, half of which has been found by the industry, and that in America a tank 1920ft. long was recently completed at a cost of £50,000. These facts speak for themselves; they show that in all shipbuilding countries tanks are looked upon as a necessity, and that money for their construction, improvement and maintenance is not wanting, even in these hard times. In Germany the position is particularly interesting. In 1922 Dr.-Ing. E. Foerster, the designer of the Hamburg tank, established a society known as the Friends of the Hamburg Experimental Tank. It numbered then 75 members, but has now on its roll no less than 1200, all of whom pay an annual subscription. The fact that such a large body of members can be kept together at the very moment when the German shipbuilding industry has almost to exist' provides very striking evidence of the German belief in tank research. It is well known, moreover, that the Hamburg laboratory is endeavouring to build up an international reputation and to secure support from foreign countries. Can we, in such circumstances be lukewarm and indifferent about our own National tanks? The sum that is required annually to support them on a firm basis is, as we have shown, wholly insignificant in comparison with the income and expenditure of the shipbuilding and shipowning industries. Even if there still be some who have no confidence in experimental researches, the tax imposed upon them to support the tanks would be a trifle to bear if only in view of the possibility that something, at some time, might happen which would be of value to them. There are in Great Britain over thirty shipowning companies and nearly forty shipbuilding firms, to say nothing of ship repairers and marine engine builders. Great Britain and Northern Ireland own 20 million tons of shipping, Germany only 4 million tons, and France, Holland, and Italy only some 9,500,000 tons between them. If money contributions to research were proportional to the tonnage owned, this country would be in a position to spend four times as much as Germany and about as much as all the rest of the world. That is not an unreasonable basis, and we cannot bring ourselves to believe that, when so much is at stake, not alone as actual financial saving, but as an improvement of our great prestige as a maritime nation, so small a sum as £2500 will not be forthcoming.

Early Electricity Supply.

Wide as his experience in the field of electricity supply has been, Captain J. M. Donaldson, the new President of the Institution of Electrical Engineers, must have found it a little difficult to prepare the presidential address which we publish in abstract elsewhere in this issue. Those who deliver addresses and lectures before the "Electricals" generally confine themselves to subjects in which they are well versed. Communication engineers deal with communication; electric supply engineers with supply problems; research engineers with research and its results, and by way of a little diversion those who are engaged in manufacture sometimes display a few goods. But Captain Donaldson was faced with the unfortunate fact that several other prominent supply men have recently been Presidents of the Institution. Since the year 1924–25, when Mr. W. B. Woodhouse was in office, Mr. R. A. Chattock and Sir Archibald Page have occupied the chair. Each of these three Presidents, naturally, discussed electricity supply, thereby leaving little more to be said about modern developments. To steer clear of the beaten track was the new President's task, and he accomplished it by confining himself largely to the dim and distant past. In history some find more interest than in present-day activities with their political associations. In bygone days power stations may have been inefficient and continuity of supply may have left something to be desired, but the early undertakings presented fascinating features which somehow the cheap and abundant supply scheme does not possess.

On the technical side in particular the work of the pioneers will always shine and continue to demand admiration. The opening up of roads and the laying of cables while the authorities were in bed or out of town may have been a little unconventional and rash, but in view of the difficulty of getting permission to put cables under the earth there was sometimes no other course to adopt. Perhaps few of the younger generation of electrical engineers realise the difficulties with which the pioneers were faced and how much the industry owes to their undaunted perseverance. With less courageous men behind the early ventures, progress might have been impaired. The Institution of Electrical Engineers' commemoration meetings held in 1922 threw much light on the early trials and troubles of the surviving pioneers, who welcomed the opportunity to put their experiences on record. Possibly if these meetings had not been held Captain Donaldson would have paid more attention to technical matters. Dividing his address into three sections, he considered the introduction of electric light into the cities and larger towns of the country; the work of the power companies when the use of extra high pressure enabled a much wider area to be covered from a single power station; and, finally, the penetration of the country which has been going on for a considerable number of years. As many have done in the past, the new President emphasised the shortcomings of the 1882 Act, which gave local authorities the power to purchase undertakings after a period of twenty-one years. Not withstanding that the gasindustry, which had been in existence for a long time, had never been subjected to any such limitation, the new industry was saddled with this handicap and, in consequence, suffered stagnation. It was not until the 1888 Act altered the period of purchase from twenty-one to forty-two years that the industry began to thrive, although before that time some companies had started electric supply in a small way. As an engineer associated with a large and important supply company, it is not to be wondered at that Captain Donaldson's sympathies are with undertakings of that kind, and that he took pains to show the important part companies played in the development of electric supply in this country. In nearly all the larger centres of population it was private enterprise which took the initiative. The case of "Central London" is of special interest because, with the exception of St. Marylebone, it is still supplied by companies, all of which were due for purchase by the London County Council last year, but which have been given a further lease of life of forty years. Among the mistakes that were made in the early days was that of founding competing companies. Not content with the consequent duplication of mains, &c., for which in the long run the consumers had to pay, the authorities insisted that the competing undertakings should have different systems. Although, generally speaking, competition is good, experience has shown that more than one supply undertaking in a given area is unnecessary. Against this error on the part of the authorities may be set the wisdom and foresight of Ferranti, who soon came to the conclusion that the City of London was no place for generating stations. Of all who took part in the establishment of the early electric power houses, none had better vision than this remarkable man, who designed and built his plant and installed it on a good site which is utilised to this day. Obvious as it now appears, Ferranti realised, quite early, that the main requirements of a generating station were plenty of space, ample water for condensing purposes, and good facilities for the supply of coal and the disposal of ashes.

Just as the power companies did and are still doing important work in the way of bringing the benefits of electricity to large areas in this country, so have they helped many of the smaller towns, although not a few towns of quite reasonable size were neglected. One of the main objects of the national scheme is, of course, to increase the availability of electricity, but as the new President explained, the presence of "grid" lines in a given part does not necessarily mean that the locality is shortly going to get a supply. Many who dwell in the vicinity of 132-kV lines no doubt imagine that they have been put there for their benefit, and they have yet to learn that they are intended for a totally different purpose. The "grid" has given rise to much misunderstanding. Perhaps, as Captain Donaldson suggested, it should have had another name, such as the "national 'bus," a name which, although appropriate from a technical point of view, unfortunately suggests road transport. Under different circumstances the new President might have been more critical, but as far as the "grid" is concerned Mr. Chattock and others have left little to criticise. In concluding his address, however, he made a wise suggestion. The electricity supply industry, he said, had long been the plaything of the legislator, and the result had on the whole been unfortunate. The time had come when the legislator might usefully occupy his mind with other matters and leave the supply industry alone to work out its own salvation. With that suggestion many will agree, for the industry is now strong and healthy. Like the grown-up boy, it no longer requires nursing and can well look after itself.

Institution of Electrical Engineers.*

It was in 1831 that Michael Faraday made his fundamental discoveries in electro-magnetism on which the whole modern practice of electrical generation is based, and, in view of the centenary celebrations it is of interest at this time to see what great results ultimately began to issue from those classical experiments. It was nearly fifty years before such practical results began to flow, and, indeed, it was not until Swan invented the carbon filament lamp in 1880 that electric lighting in its wider uses became at all possible. Before that date, of course, the arc lamp had been used for the lighting of streets, large buildings and, indeed, some private houses; but the limitations of this method were obvious, and it was not until the "sub-division of the electric light," as it used to be called, had been made feasible by Swan's invention that real progress was possible.

It must be remembered that it has always been possible to supply electricity to a limited extent without any legislative powers whatever, and as long as one's mains are laid on private property there is nothing to limit the activities of anybody who wishes to give general supply. It is also possible for supply mains to cross the public roads as long as this is done overhead, and, indeed, in some cases, arrangements were made by early suppliers to open up public roads with the permission of the local authority. This, of course, was an unsatisfactory state of affairs, and legislation was therefore introduced in 1882 giving undertakers—to use the quaint name which has always been applied to the members of the supply industry—the right to open up public roads under certain conditions and naturally with certain obligations attached to the privilege. Unfortunately, however, as has been frequently stated, the Act of 1882 entirely failed of its purpose because it laid down a limit of twenty-one years, after which the undertaking could be purchased by the local authority on terms not altogether definite, but distinctly unfavourable. The Act of 1888 altered the period of purchase from twenty-one to forty-two years, and this gave an immediate impetus to enterprise. Before this, however, some bold companies had started electricity supply in a small way, but not much was done until shortly after the passing of the second Act.† The table gives a list of some cities and larger towns where the supply of electricity was inaugurated by a company and subsequently taken over by the municipality, presumably after the undertaking had been sufficiently established. On what terms these undertakings were taken over I do not know, but, whatever was paid, one can be certain that the purchasing undertaking received a good bargain, although nobody at that date could have anticipated the enormous strides in production which subsequently took place.

It will be seen that in nearly all the larger centres of population—and indeed it was only in such centres that electric lighting appears to have been considered

* Abstract of Presidential Address delivered by Captain J. M. Donaldson before the Institution of Electrical Engineers on Thursday, October 22nd.

† The first municipality to give a supply of electricity appears to have been Bradford, who started in 1889. Newcastle—company—followed in 1890, and then a considerable number of towns, including Manchester, started in 1893.

a possibility in the early days—it was private enterprise which took the initiative, and it may perhaps be surprising to some of us now to look back on the time when all the great cities in this country were supplied by companies. In some cases the supply

Place.	Supply begun by company.	Taken over by local authority.
Brighton	1882	1891
Eastbourne	1882	1900
Hastings	1883	1898
Liverpool	1883	1896
Glasgow—		
Muir, Mavor and Coulson	1884	1892
Kelvinside Electric Co.	1893	1899
Birmingham	1891	1900
Southampton	1891	1896
Sheffield	1892	1899
Preston	1892	1922
Hove	1892	1913
Leeds	1893	1898
Norwich	1893	1902
Woolwich	1893	1902

was inaugurated without the formality of obtaining a Provisional Order. This was, for instance, the case in the central part of Glasgow.

It will be noted that London does not appear in this list. The reason is that the major part of Central London, to use a loose expression, was supplied in the first instance by private enterprise, and is still so supplied, with the one exception of St. Marylebone, which was taken over by the local authority some years ago. The position in London was always very peculiar, and the authorities in their wisdom introduced a system of competing companies, with the idea, no doubt, of obtaining cheaper and more satisfactory supply.

In 1930, however, all these London undertakings were due for purchase by the controlling authority, which was at that time the London County Council, and after a considerable amount of inquiry the decision was reached that the companies were to be given a further lease of life of forty years under strict conditions in regard to the relation of price and profits. The conditions imposed were necessarily of a novel character and might perhaps be improved after experience, but in the result the position has been stabilised and good results seem likely to accrue.

The position in London which was caused by the probability of purchase produced two strong power station groups, whose position is set out in the two Acts of 1925 entitled London Electricity (No. 1) Act, 1925, and London Electricity (No. 2) Act, 1925. The London Power Company, which is not a power company in the strict parliamentary sense of the term, has been carrying out in a quiet and unostentatious manner a remarkable work of unification and consolidation. The company controls and has linked up power stations at Deptford East and Deptford West, Bow, Grove-road, and Acton-lane, Willesden; and the new Battersea station, which is in process of erection, will, of course, be linked up likewise. The combined energy output of this group of stations amounted for 1930 to 819 millions of units and the maximum demand was 283,400 kW. The other group consists of the County of London Company and its allies and the City of London Company, between whom there is liaison, but the companies retain their independent entity. The County of London Company's main power station is at Barking, where approximately 240,000 kW of plant is now installed, and it is at the present time the largest power station in the United Kingdom. A further extension of 150,000 kW has been authorised. The total sales of the County of London Company for the year 1930 amounted to 448 million units and the demand was 157,800 kW, although in this case a considerable proportion of the output was sold outside London.

It is probably not realised by everybody what a very important work has been carried out by the great power companies in this country, but it is true to say that the foundation of the power companies marks the most important advance in the general distribution of electricity in this country after its first introduction. I could have wished that one of our past-presidents, Mr. Woodhouse, who may be called the *doyen* of the power companies' engineers, had had to deal with this matter, but I am giving in a somewhat compressed form the leading facts about this very important development, with which I am proud to have been connected in a minor way.

The consideration of this matter follows very naturally from the practical results obtained in the earlier London developments of the electricity supply companies. The difficulty of municipal or, perhaps we should rather say, parish boundaries was soon felt, and indeed this still remains one of the barriers to widespread distribution, whether it be of electricity, gas, water, drainage or the like. The two former commodities are particularly affected, as they are not concerned with differences in levels, which may otherwise determine suitable boundaries for the handling of flowing liquids.

In the second place it became very clearly evident that the City of London, for instance, was no place in which to build a power station, even in those days. Ferranti got over the difficulty with his Deptford power station by taking the mains along a private railway wayleave, although it was in his mind at one time to use overhead lines. The City of London Company, when they built the Bankside station, obtained an order for two parishes of Southwark, in one of which the power station was situated, and had merely to cross bridges in order to get into their territory. This is the cause of the extraordinary situation that the Southwark municipality does not supply in the whole of their area. The Charing Cross and City Company originally had a station in Lambeth on the south side of the river, outside their area of supply, and they made some confidential and, I fear, illegal arrangements with the then Lambeth Vestry to enable them to take the cables along the Commercial-road and then on to private property and so across the river. So doubtful were the company of the legality of their proceedings that they took the trouble to start the work on Good Friday, 1895, and to work right through the holiday so as to prevent the possibility of an injunction. Later on, however, the Charing Cross and City Company erected a station at Bow, and, in like manner, the Metropolitan Electric Supply Company put up a station at Acton-lane in Willesden, but, of course, they had to get special authority from Parliament for doing this.

In 1898 a very important Committee, known as Lord Cross's Committee, was appointed, and its terms of reference were to consider, among other things, whether special powers should not be given "for the supply of electrical energy over an area, including districts of numerous local authorities, involving plant of exceptional dimensions and high voltage and under what conditions ought such powers to be conferred upon promoters seeking to supply electrical energy in bulk to other undertakers and not directly to consumers." At this time the possibilities of extra high-pressure transmission were visualised, also the necessity of large power stations to enable current to be generated more cheaply, and the desirability of making it possible for large power users to obtain current at low rates. The result of this Committee's deliberations was to find that such power supply organisations were desirable and that they should be given perpetual powers of supply. It is this latter condition which is the distinguishing feature of the power company, and, without such a concession, it would certainly have been impossible to have carried out the work which has actually been achieved.

Now it is important to note that there was no general Act of Parliament establishing power companies at all, but that an influential Committee considered the matter, took evidence and, on the basis of its findings, various private Bills which were submitted to Parliament received the Royal Assent, and so the power companies came into being. Broadly speaking, their functions were to supply power in bulk to various distribution authorities and also to supply power direct to large power consumers. In all cases such companies had within their boundaries large and small municipalities, and usually they were definitely prohibited from supplying power in any of these areas, while in some cases they were restricted by what is known as the "Kitson" clause, which came, however, to very much the same thing.

It hardly needs pointing out that to organise a system of this kind is by no means easy, since one has no nucleus from which to start. In other words, it is quite a different problem from that of starting a supply in a big town, or even a small town, or again from extending the distribution boundaries of a town where a supply is in existence. Moreover, prospective power users were much more wedded to their old systems of independent generation, and, indeed, it is even now a matter of pride to some firms that they have a steam engine which has been working for, say, half a century. In these circumstances, it is not surprising that, although a number of Bills were put before Parliament and eventually became Acts, there was no very great desire among promoters to deal with this class of business. Some of the Acts were, indeed, hawked round the country for a considerable time, and in all cases it was not for many years that a dividend was paid on the ordinary shares. Consequently, although at the present time the shares of power companies stand very high in the market owing to the good results which have been obtained, this has been the result of very arduous work in the past and a great deal of sacrifice on the part of those who originally put money into the business. In considering the present prosperity of these undertakings, one has to bear in mind the "lean" years which most certainly preceded the present state of mild prosperity and stability.

The position at about the end of the last century was that, owing to the recommendations of Lord Cross's Committee, the way was left open for the supply of power on a large scale, and it was obviously to the industrial districts of the country that attention was first turned.

The Newcastle Electric Supply Company remains easily the largest of the companies, and, with its allies, it has the most widespread territory. The operations of the company really began in 1901, when Lord Kelvin inaugurated the supply from the Neptune Bank station. At the time, this station was considered to be a very large one, but, in point of fact, the main generating units consisted of four 700 kW generators running at 100 r.p.m.—an installed capacity of between 2000 kW and 3000 kW. The present installed capacity of the company is over 300,000 kW, and this gives a measure of the growth of the business. It is interesting to note in this connection that the engineer of the original scheme, and, indeed, the consulting engineer to the company now, is Mr. C. H. Merz—our latest Faraday Medallist.

In addition to the pioneer work in the big towns, a large number of the smaller towns now obtain the benefits of electricity, and this work was, I think, generally done by private enterprise, but it is really surprising to find how many towns of quite a reasonable size were left entirely untouched and considerable areas completely neglected. This state of affairs is being rapidly remedied and, indeed, it is very necessary that it should be, otherwise it will be quite impossible for the country to get the full benefits of the grid system of the Central Electricity Board. Unfortunately, many people are under the impression that the great lines which they see going up will immediately bring a supply of current to the houses which they closely approach, and bitter disappointment is created when they are told that nothing of the sort will happen.

The connection between town and country is now so close that many dwellers in the latter are well aware of the low prices of electricity which are charged in many of the towns, and they appear to consider that the fact that the price of electricity in the country is considerably higher than in the towns is an anomaly and a grievance. It cannot, however, be too strongly pointed out that the cost of supplying electricity in the rural areas depends a great deal more on the density of the population than on anything else; in other words, on the revenue per mile of main, and that even if the current were supplied for nothing, the prices for lighting, at any rate, would certainly be higher than they are in the towns. Once this point is appreciated, matters fall into their true proportion and it is recognised that the only possible way of reducing prices in the country areas is by a very much larger use of the facilities afforded, and it is on these lines that all enterprising authorities are now working.

Literature.

Mining Electrical Engineering. By H. Cotton, London: Chapman and Hall, Ltd. Price 15s.

Written with the object of meeting the requirements of those who are working for some recognised qualification in mining electrical engineering, such as the certificates awarded on the results of the examinations of the Association of Mining Electrical Engineers, this book can scarcely fail to meet with appreciation. If the recommendations of the committee appointed some little time ago to inquire into the qualifications and recruitment of officials in mines be adopted, responsible electricians at collieries will be expected to show that they possess some recognised qualification which will be largely based on the results of a written examination. In anticipation of this state of affairs, Dr. Cotton has written this book, which is full of information useful to colliery electricians, and particularly to those who are preparing for the examination of the Association of Mining Electrical Engineers.

Nor is the book without value to others engaged in other industries in which electricity is employed, for much of what the author has to say about electrical engineering materially applies to work besides that of mining. All who desire to acquire knowledge which will help them to become efficient charge electricians will find the volume useful and easy to understand. Throughout the volume, however, the special requirements of mining men have been kept well in view, and the many numerical worked-out examples are as far as possible concerned with mining problems. As an introduction to the author's more advanced and specialised treatise, "Electricity Applied to Mining," the new volume is probably unrivalled. It deals with the principles of both D.C. and A.C. work, and is based on the result of ten years' experience in teaching all classes of mining men.

Like most other books that deal with special branches of electrical engineering, the early chapters are devoted to elementary matters that must be mastered by all electrical students. Following chapters on the electric circuit, power and energy and magnetism, come several which are of a more practical nature, and deal with things that come under the electricians' care, such as primary and secondary cells, dynamos and motors, transformers and electrical measuring instruments. Attention is also paid to the important subject of illumination. The chapters on A.C. and alternating machines and apparatus, though necessarily more difficult than most of the other chapters, have been carefully and simply written, and the fact that the majority of mining electricians are not likely to be expert mathematicians, has been kept well in mind.

BOOKS RECEIVED.

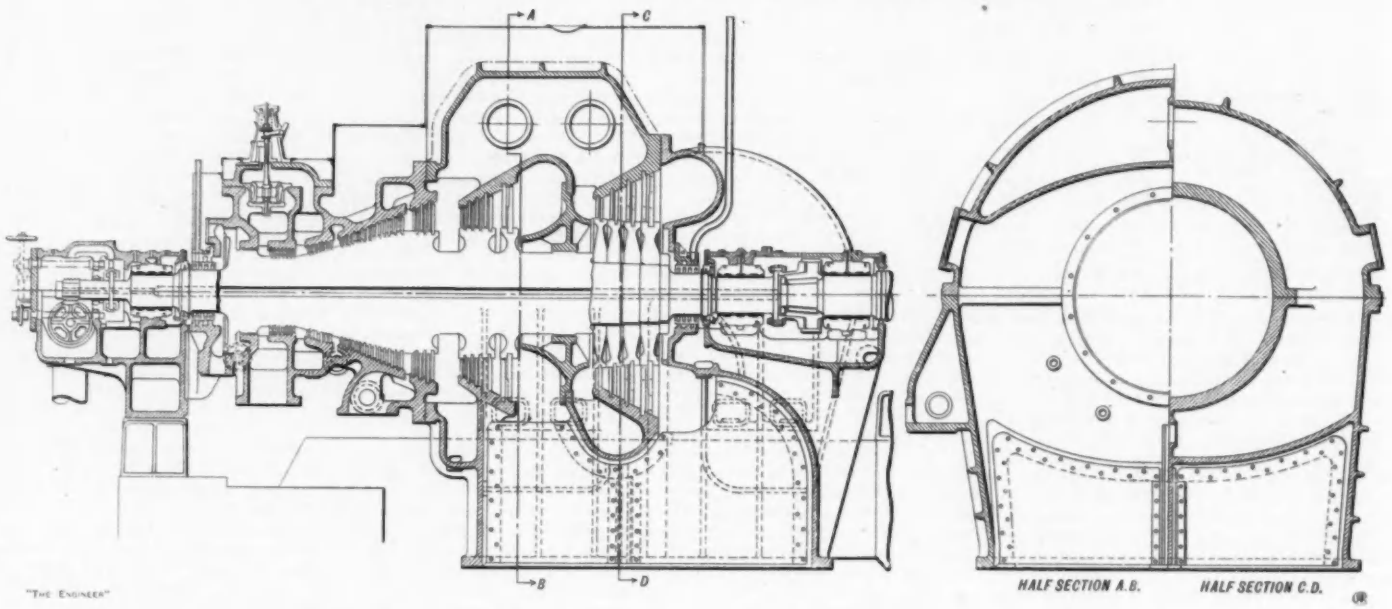
The Preparation, Selection and Distribution of Coal. London: The Institute of Fuel, 53, Victoria-street, S.W. 1.

European Exchange Tables. By L. S. Dee. London: Gall and Inglis, 13, Henrietta-street, W.C. 2. Price 2s. net.

The "Express" T.C.Q. Weights Pricer. London: Gall and Inglis, 13, Henrietta-street, W.C. 2. Price 2s. 6d. net.

20,000-kW DUPLEX-EXHAUST STEAM TURBINE

C. A. PARSONS AND CO., LTD., NEWCASTLE-ON-TYNE, ENGINEERS



The Parsons Duplex-Exhaust Turbine.

The demand for steam turbines of ever greater power and efficiency has brought home very forcibly the limitations to output imposed by the exhaust area. Considerations of centrifugal force determine the maximum peripheral speed of the final blade-row, and this, in turn, fixes the outer diameter of the exhaust annulus for any given speed of rotation. The maximum blade length is equally fixed, partly by questions of strength and partly by the necessity of avoiding undue differences of pitch and blade speed between the two ends of the blading. The maximum area of the annulus is thus settled almost regardless of the wishes of the designer. The quantity of steam which can leave the turbine through this annulus depends jointly on the density of the steam and the velocity that is permissible. Since the density is fixed by the pressure down to which the steam is to be expanded in the turbine, the output of the latter, for a given speed of rotation, is limited by the velocity at which the steam is allowed to leave the blading. This velocity represents, of course, a pure waste of energy, and, hence, it cannot exceed a moderate figure without detracting sensibly from the overall efficiency of the machine. For a given rotational speed a given vacuum, and a given efficiency, we have, therefore, an output which cannot be exceeded by a simple turbine. Of course, when steam is extracted from the turbine for feed-heating or other purposes before reaching the exhaust, the conditions are altered to a certain extent; but it is, nevertheless, generally true that the output of a turbine is limited by the area of the exhaust annulus, which, in turn, is fixed by mechanical considerations, as has been shown. A greater output can only be obtained by permitting greater leaving losses and, therefore, at the expense of efficiency.

In the case of fairly large turbines, the difficulty of providing sufficient exhaust area was met, many years ago, by C. A. Parsons and Co., Ltd., by the employment of a separate double-flow, low-pressure cylinder. The device enabled twice the exhaust area of a single-flow arrangement to be obtained, and, therefore, twice the quantity of steam could be used efficiently in the turbine. Its widespread adoption in turbine practice is sufficient evidence of its merits, but the design necessarily involved a turbine having at least two cylinders. It, therefore, afforded no solution to the problem of the single-cylinder turbine. The latter, of course, could have been built on the double-flow principle, with an exhaust at each end, and, indeed, this was the construction adopted for the pioneer Parsons turbine of 1884. Such a turbine, however, is really the duplication of a single-flow machine of half the output, and its efficiency is limited by this fact. There is, moreover, no effective gain in exhaust area by the design, because such exhaust annulus has to deal with the whole of the steam from its own high-pressure blading.

To provide sufficient exhaust area to enable large outputs to be efficiently obtained from single-cylinder turbines working on high vacuum, C. A. Parsons and Co., Ltd., have originated the special type of machine illustrated in engravings on page 464. This particular machine was built to the order of the Derby Corporation in connection with the latest extensions to its power station and has now been in service for sufficient time for the merits of the design to be confirmed by experience. The turbine has a rated output of 20,000 kW at 3000 revolutions per minute, and is believed to be the largest single-cylinder machine at this speed ever built in this country. In making comparisons with large machines of foreign design, it must be remembered that great outputs can always be obtained at a sacrifice of efficiency, which would not be tolerated in general by British customers. The Derby turbine is essentially a high-efficiency machine, and, owing to the special features of its design, it is able to take full advantage of the 29in. vacuum with which it works.

The turbine is of the pure reaction type and is remarkable for its short overall length. The distinguishing feature of its construction is the duplex exhaust. The steam, which has a pressure of 290 lb. and a temperature of 700 deg. Fah. at the stop-valve, expands down to an absolute pressure of about 4 lb. in the blading, exactly as in an ordinary Parsons single-cylinder reaction turbine. The steam flow is then divided, part of it going straight on through five more pairs of blade-rows to the first exhaust outlet, and the remainder being led away through a passage in the top half of the turbine cylinder. This steam is caused to flow through four pairs of blade-rows on its way to the second exhaust outlet. In each the steam is expanded down to a final pressure of 1 in Hg absolute, and the two parts of the flow reunite in a common exhaust branch through which the steam is led to the condenser.

The appearance of the complete machine is illustrated on page 464, and the details of design will be well understood by reference to the other engravings and the drawing on this page, the latter showing two half-sections through the by-pass belt. The rotor, of which a separate photograph is reproduced on page 464, is composed of a single shaft, on which four discs are mounted to carry the blading pertaining to the second part of the duplex exhaust. The use of discs for this purpose avoids the difficulties met with in forging large rotors in one piece. In accordance with Messrs. Parsons standard practice, the discs are butted together both at their rims and their centres. Disc vibration, which is so prevalent a source of trouble in turbines having separately mounted wheels, is, therefore, rendered impossible. It may also be mentioned that before being shrunk on the shaft, each disc is run up to an overspeed which definitely stretches the eye, so that, when the disc is stationary, the material round the bore is in a state of compression. Besides the security which so severe a test provides, the metal of the disc is left in the best state to withstand the working centrifugal forces, while the absence of any holes through the discs for pressure balancing, still further contributes to the strength of the rotor. The blade heights increase from 1·5in. at the inlet, where the rotor is 22in. diameter, to 15in. on the final disc, the diameter of which is 44in.

The lower part of the casing, as it lay in the erecting shop after blading, and the stator and rotor of the alternator are illustrated in engravings on page 464. The alternator is of the standard Parsons type, with a maximum continuous rating of 20,000 kW at 3000 revolutions and 0·80 power factor. It generates three-phase current at 6600 volts, with excitation by an exciter on the end of the shaft. Voltage regulation is carried out entirely in the exciter shunt field circuit. The stator core conductors are of the makers' patented helically stranded coreless cable. The rotor is of the barrel type, the windings being accommodated in radial slots milled out of the solid steel forging. The coupling shown on the end of the shaft, in the photograph, is a temporary one put on for balancing purposes. The cooling of the alternator is carried out on the closed circuit system. The cooling air enters the stator along its whole length and round its whole circumference, thus giving a highly effective and uniform cooling effect.

The machine was designed for high efficiency, the guaranteed steam consumption at the most economical load of 16,000 kW being 9·2 lb. per kWh, and 9·84 lb. at a load of 8000 kW under conditions of no feed-heating. The official tests showed that the actual efficiency was well above that guaranteed, the specified figures being beaten by between 1 and 2 per cent. The heat consumption of the machine under feed-heating conditions is 11,710 B.Th.U. per kWh, an excellent figure for a turbine of the size, working with steam at 290 lb. gauge and 700 deg. Fah. only. A smaller turbine of the same type, with an output of 15,000 kW at 3600 revolutions, constructed by C. A. Parsons and Co., Ltd., for the City of Regina, in Canada, has a heat consumption of only 11,207 B.Th.U. per kWh, the steam conditions being 350 lb. and 725 deg. Fah. at the stop valve.

It is evident that the principle of the duplex exhaust enables the advantages of the single-cylinder turbine, as regards simplicity and smallness of space occupied, to be retained, in many instances, with no sacrifice whatever in efficiency. Furthermore, the idea can be extended by combining a duplex exhaust, high-pressure cylinder with a double-flow, low-pressure cylinder. Such a machine was illustrated in Mr. C. D. Gibbs' recent paper before the Institution of Mechanical Engineers. A three-exhaust turbine of this type enables a unit of 50,000 kW at 3000 revolutions to be constructed of very reasonable length, without loss of efficiency.

Roll Heating.

(Contributed.)

The article on the electric induction system of roll preheating which appeared in your issue of April 24th, raises several interesting and controversial points, and in view of this, a short *résumé* of the information available from South Wales, the home of the sheet and tin-plate industry, will probably be of general interest.

Prior to the adoption of preheating of rolls on Monday mornings, it was customary to start the mill with cold rolls at the usual time, rolling nail or bar iron. It has been found that approximately 5 tons of such material has to be passed through each mill before the rolls are heated sufficiently to commence on sheets. Heating up with narrow bars is objectionable, as it disturbs the smooth surface of the rolls, so that even after the rolls are up to the proper temperature, the first sheets rolled are not of first-class quality, nor can they be of the thinnest gauges or of full width. In these conditions, very few works in South Wales were able to produce first-class sheets of light gauges before the second shift of each week.

The inferior goods turned out during the first eight to sixteen hours each week, had, in every case, a market value much below first-class sheets; in addition, such large quantities of nail iron were produced that much of it was sold at no profit, and a great deal at an actual loss. Bars cost about £5 per ton and nail iron was sold at a similar figure, whereas sheets are worth anything from £9 per ton upwards.

An average mill has a production of about 100 tons per week of 125 working hours, so the fact that it was impossible for some 6 to 12 per cent. of the whole output of any mills to be of first quality goods was a serious matter.

The object in view when introducing preheating of rolls was to remedy this state of affairs and to enable the mills to start first thing on Monday morning rolling good quality sheets. This has been satisfactorily accomplished with a small outlay on fuel oil burners, and very low running costs.

In addition to enabling mills to turn out sheets instead of nail iron on Monday mornings, the system of roll preheating has revolutionised the nail iron market, so that, at the present time, whatever nail iron is rolled can be sold at a profit. A moderate estimate of the savings effected by roll heating through increased value of the output would be £30 to £35 per mill per week. Such an amount in a works with possibly fifteen mills, represents a very substantial sum.

In the case of tin-plate mills, the savings effected are, roughly, in proportion to the throughput, a normal saving due to preheating being £125 per mill per annum. It will be appreciated that the tin-plate mills have, in most cases, some market for small size sheets, which can be rolled from the small parts of the bars that are trimmed off and used for preheating the rolls during the first shift of the week.

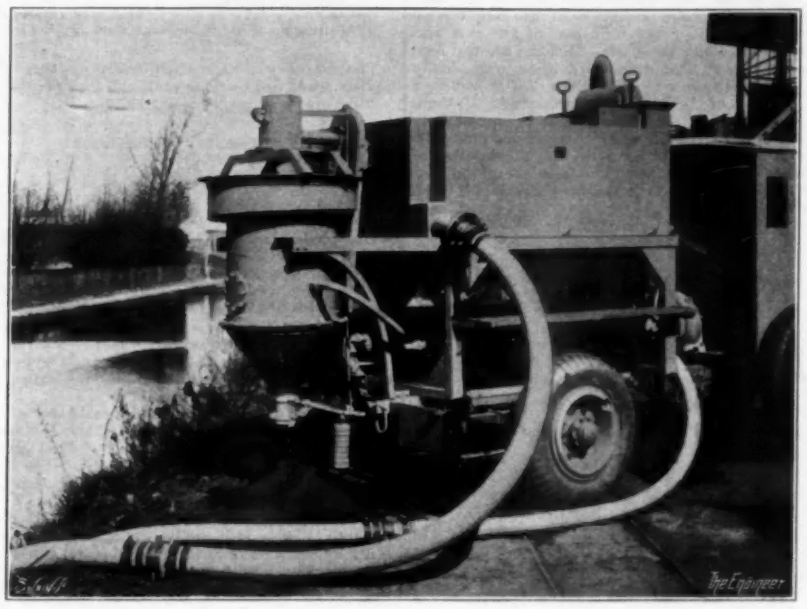
The preheating of rolls has brought up the question of roll breakages, and attempts have been made to show that the number of breakages is affected by the preheating process.

First of all, it may be as well to point out that none of the oil-burning plants installed for roll heating has been put in because of any idea being entertained by mill managers that the breaking of rolls was in any way affected. The sole object, as stated above, was to be able to roll good-class sheets throughout the working hours. Many works have only adopted roll preheating recently, so that insufficient experience is available from them, but in the case of all the mills which have been using the process long enough to be able to form an opinion, it is stated emphatically that roll preheating has no bearing whatever on roll breakages. It is necessary to qualify this by pointing out that by misuse of a preheating burner, owing to inexperience, it is possible to damage rolls; but in practice, as care is always taken to bring the rolls up to temperature slowly and to distribute the heat properly, no damage at all has been done anywhere, and no difficulty is experienced in the preheating operations.

The actual cause of roll breakages has been the subject

A PORTABLE HYDRAULIC CLASSIFIER

THE KEY ENGINEERING COMPANY, LTD., LONDON, ENGINEERS



of much discussion and investigation, but still remains somewhat of a mystery. Those best qualified to speak on the subject, however, state that the breakages are mostly caused by the way the mills are operated by the men, while subsidiary causes are defective castings, varying depth of chill, and the bars coming from the mill furnace, either insufficiently or not homogeneously heated. The results obtained to date are such that no mill manager in South Wales can produce any data to show that breakages are either improved or the reverse by the preheating process.

Considerable improvements in average roll life have, however, been effected by carefully watching the operation of the mills and by instructing the men as to the best method of working. The average life of rolls varies considerably between various works, even between those using exactly similar methods for preheating, and this supports the contention that the method of operation affects the results.

It is a fact that two rolls of the same size, manufactured at the same time by the same maker, may be put to work in adjacent mills on the same class of work, and one may break the first day and the other last until it is worn out by the chill being removed by regrinding.

The chill of the roll being hard, and therefore of a different metallic structure to the core, behaves in a rather different manner under the influence of heat. The most recent view being that this is due to the difference in the thermal conductivities of the core and the chill. For this reason, too rapid a rate of heating of the chilled skin is objectionable, whatever method is used.

A Portable Hydraulic Classifier.

The measurement of the total load of silt carried by a river presents a very difficult problem. In any one part of the river the load carried can be classified in the three forms of rolling silt, saltatory silt, and suspended silt, but the class to which the silt belongs depends largely upon the amount of water in the river, the shape and depth of the channel, and other factors. Suspended silt can be measured with a fair degree of accuracy by drying off known quantities of water, but to measure tractional silt is far more difficult. It is well known that silt finer than 100 mesh is likely to cause little trouble, while that causing the most inconvenience contains a large proportion of particles greater than about 10 mesh. In practice, therefore, it is only necessary to measure the quantity of silt coarser than 100 mesh.

In order that measurements may be made readily, on site, the Key Engineering Company, Ltd., of 4, Queen Victoria-street, is marketing the portable classifier which we illustrate on this page. One of these plants was recently supplied through the Crown Agents to the Federated Malay States. It was designed by Mr. Leonard Andrews to the specification of Mr. D. H. Laidlaw, late Chief Hydraulic Engineer to those States, who wished, in particular, to measure the silt held by streams resulting from mining operations rather than natural silt. It was suggested by Mr. Laidlaw that a classifier might be mounted upon a lorry, and that a large proportion of the flowing stream could be pumped through it, the solid matter in suspension greater than 100 mesh being discharged in a heap whilst the water with fine loam, clay, &c., would be returned to the main stream.

The principal difficulty in meeting the specified requirements was the large quantity of water to be handled to collect a reasonable sample of solid matter. It was estimated that under normal conditions the classifier would be required to handle about 12,000 gallons of water per hour to collect about ½ ton of solids. This difficulty was satisfactorily overcome by means of the plant shown diagrammatically in the drawing.

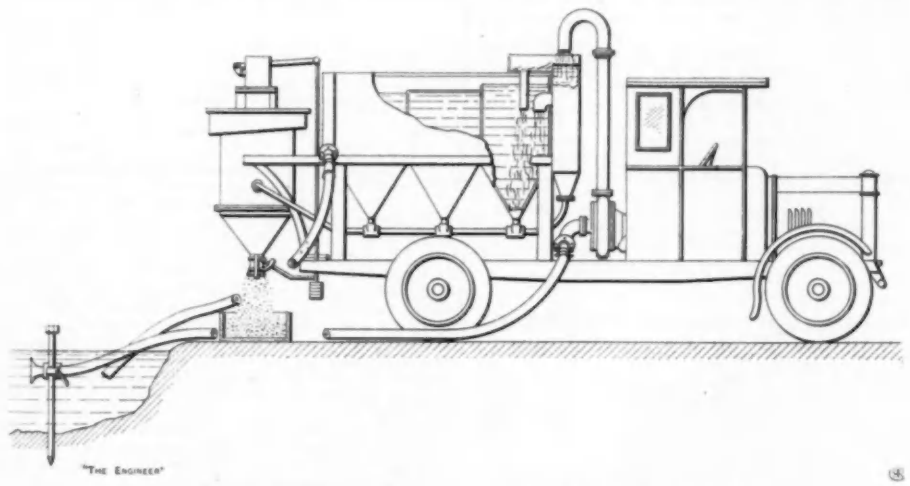


DIAGRAM ILLUSTRATING ACTION OF HYDRAULIC CLASSIFIER

The stream is caused to flow through an Andrews standard Underflow classifier, the purpose of this component being in this case to concentrate the solids to a reasonable density for subsequent de-watering in a secondary classifier of the Andrews standard sandgate mechanism type. This type of classifier is fitted with an automatically operated valve which discharges the solids without allowing the water to escape.

A 3in. centrifugal pump, mounted on the chassis of a 30-cwt. Albion Motor Car Company's lorry, is driven by the motor car engine through a special attachment to the standard running transmission gear. The flexible suction hose terminates in a bellmouth intake placed in the main stream with its opening normal to the direction of stream flow. The pump delivers water and solid matter to the feed hopper of the Underflow classifier. The hopper is provided with a removable basket screen which serves to trap gravel, &c., exceeding ¼in. diameter. A 1¼in. outlet pipe connected to the bottom of the feed hopper communicates with the final classifier, while a larger outlet at the side of the feed hopper communicates with the main tanks of the Underflow classifier.

By means of adjustable weirs the water in the feed hopper is maintained at a sufficient head above the other portions of the plant to ensure a velocity in the Underflow pipe sufficiently high to carry all solid matter of ¼in. and smaller to the mechanical classifier, the remainder of the water flowing at a low velocity through the tanks of the Underflow classifier.

The sand, silt, &c., carried in suspension in the low velocity tanks, sinks to the lower portions of these tanks, and is discharged through the conical connections to the Underflow pipe, whereas mud, clay, and fine silt of less than 100-mesh diameter remain in suspension and are returned to the stream with the water through a pipe connected to the last of the low-velocity tanks.

The rate of flow of the water passing through the classifier is measured and kept constant by noting the depth of flow over the weirs in the low-velocity tanks, so that by collecting and weighing the solid material the weight of silt carried in suspension in a known volume of water can be readily ascertained.

It was originally thought that it would be necessary to collect samples of the solid discharge and of the water overflow for screen and elutriation analysis, with a view to deducting from the weight of the solid discharge the percentage minus 100 mesh and adding the computed weight of plus 100-mesh material carried in the water overflow. It was subsequently decided to aim at so proportioning the velocity in different portions of the plant that the minus 100 mesh in the oversize would approximately balance the plus 100 mesh in the overflow. It was felt that if this was possible the mere measured weight of the sand discharge divided into the volume of water would give a sufficiently accurate indication for all practical purposes.

Before shipment of the plant, it was tested in this country, in the presence of Mr. D. H. Laidlaw and a representative of the Crown Agents, with the very satisfactory results shown in the following table :—

Period of test	1 hr. 20 min.
Total volume of water pumped through classifier	13,200 galls.
Weight of dry sand collected	816 lb.
Computed weight of plus 100 mesh sands carried in overflow	42·8 lb.
Weight of minus 100 mesh sands contained in collected solids	37·6 lb.
Difference = 5·2 lb. = 0·66 per cent. of collected solids	
Temperature of water in the radiator tank of the engine at the end of the run	160 deg. Fah.
Air temperature	50 deg. Fah.

The pump, controlled by the governor on the engine, maintained a sensibly constant rate of flow of water throughout the test.

The Key Engineering Company, Ltd., of 4, Queen Victoria-street, London, E.C. 4, which is marketing this plant, anticipates that there will be applications for its use in other directions than the purpose for which it was originally designed.

B.E.S.A. SPECIFICATIONS.

All B.E.S.A. Specifications can be obtained from the Publications Department of the Association at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

PHOSPHOR BRONZE GEAR BLANKS.

A specification providing for the chemical composition and physical properties of phosphor bronze castings for gear blanks has been issued. The specification covers centrifugal castings, chill castings, and sand castings, and the manner of providing test samples for each of these methods of casting and for castings of various weights, is detailed. Tensile tests and Brinell hardness tests are specified, whilst general clauses dealing with testing facilities and the freedom of the castings from defects are included.

GALVANISED STEEL WATER CONTAINERS.

The British Engineering Standards Association has issued a British Standard Specification for Galvanised Mild Steel Cold Water Cisterns, Hot Water Tanks and Cylinders (B.S.S. No. 417–1931). In addition to providing for the standard sizes of tanks and cylinders, two grades of thickness are included, enabling the architect or engineer to specify the appropriate grade for his purpose. The specification provides tests for pressure and the quality of the galvanising. Under this specification tanks will be recognised by their British Standard Number, nominal capacity and grade, these details being stencilled on the finished article.

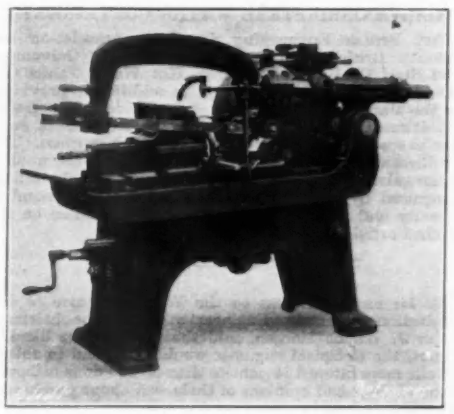
In his recent address to the Western Centre of the Institution of Electrical Engineers at Cardiff, the chairman, Major J. Wayne Morgan, said that whether he liked it or not, the electrical engineer would be bound in future to take more interest in politics than he had done hitherto. Some of them had opinions of their own about purchasing electricity in bulk in preference to generating it themselves, but, in the interest of the national weal, they must all unite to ensure the grid scheme's success. Commercially it was essential, the more so in view of recent events, that the fullest possible use be made of the service offered by the Central Electricity Board. A dangerous aspect was the possibility of the grid becoming a plank for party politics, for, if political and not engineering considerations were allowed to become deciding factors, nothing but failure could be expected. The electrification of the main line railways was open to discussion, although conversion might bring about a steady and welcome supply of work, spread over a period of years. He sincerely hoped that the final decision would be based on engineering facts, not on political policy. Perhaps the industrial difficulties of the country might be due, at least in part, to the fact that the Government had been so largely in the hands of "professional politicians." It was essential for the engineer to take a greater part in the government of the country, although he hoped that those who did would remain engineers and not become "professional engineering politicians."

A Governor Feed for a Sawing Machine.

The full-speed sawing of joists, channels, and other similar sections often presents some difficulty, owing to the large variations of cross section in the parts being cut. Not infrequently the machine may need constant attention. For the smaller sizes it is usually necessary to reduce the sawing pressure and run the machine at a slower speed, the reasons for the necessity being the weakness of the parts being cut and the fact that on narrow sections a great strain is thrown upon the few teeth that are in operation at any one time.

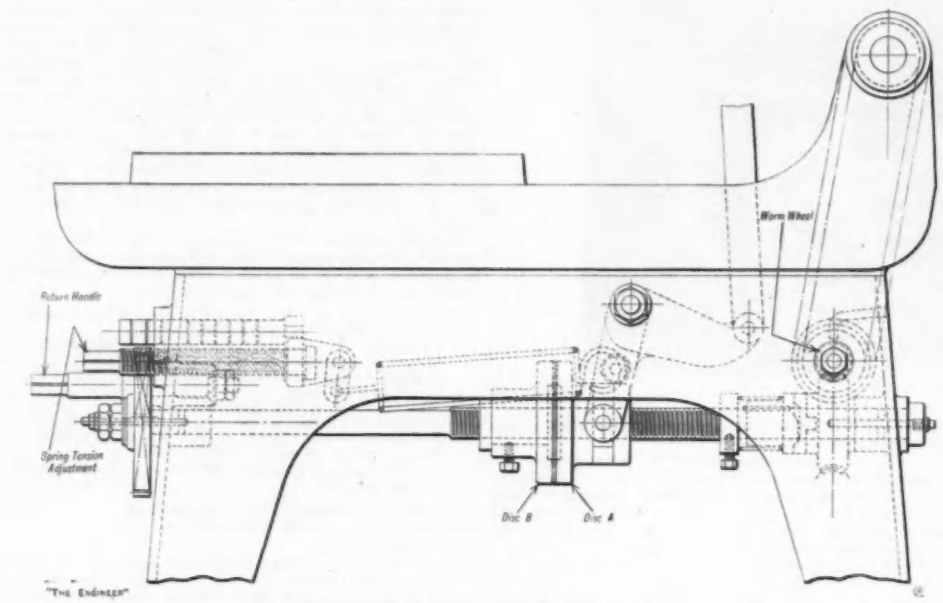
With the object of overcoming the difficulty, the firm of Edward G. Herbert, Ltd., of Manchester, has recently introduced a governing device for sawing machines. The engraving on this page shows one of that firm's "Rapidor" sawing machines to which such a device has been fitted, while a drawing indicates the nature of the governor mechanism. The governor is so constructed that while, when the saw is operating upon thick sections, maximum cutting pressure is exerted, that pressure is reduced and the rate of feed controlled when the saw blade reaches a narrow section. The operation is entirely automatic.

A spring mounted below the tray of the machine is responsible for applying the load to the saw. It acts through a bell crank lever and two links on to the guide bar of the saw. When a governing device is fitted, that arm of the bell crank which is attached to the spring is lengthened and attached by pin joints to a part shaped much like an ordinary half coupling which we have called disc A. This disc is capable of sliding along—but not turning upon—a screwed governor shaft, which is mounted below the tray of the machine and rotated from the main shaft through a chain drive and a worm and wheel reduction. Abutting against the face of the first disc A there is another, B, there being a pad of Ferodo between them. This second disc is attached to a nut threading with the screwed governor shaft, and it is freely mounted so that it can turn with that shaft or rotate or slide upon it.



SAWING MACHINE FITTED WITH FEED GOVERNOR

Suppose that the saw is cutting a thin section. Under the influence of the pressure it feeds too rapidly and tends to "dig in." The governor, however, prevents such an event happening. The disc A being connected with the saw, is moved along the governor shaft as the saw feeds through the work. Its face is in contact with that of disc B, and consequently the latter is held and cannot rotate with the governor shaft. Disc B, in turn, holds the nut to which it is attached, and since the shaft is rotating, both disc and nut traverse along it under the influence of the screw thread. In consequence, disc A, which is making contact with disc B, can move no faster than the speed of rotation of the governor shaft permits, and as a result the saw, which is connected to that disc, is not allowed to feed too rapidly. The speed of rotation of the governor shaft is, of course, set to give the maximum safe speed of feed for a light section. When cutting heavy work, the governor interferes not at all with the natural feed of the saw. As before, the disc A makes contact with disc B and holds it, and the latter, under the influence of the nut and screw, is traversed along the shaft. But the natural feed of the saw is slow, so that disc A traverses more slowly along the shaft as the saw feeds in than disc B traverses under the influence of the screwed governor rod. If, then, disc B is momentarily held by disc A, it is immediately traversed out of engagement, and is thus moved along the shaft without interfering either with the movements of disc A or those of the saw. It will be seen, therefore, that although the device prevents the saw "digging in" when it meets thin sections, it has no effect upon the rate of feed when thick sections are being cut.



FEED GOVERNING MECHANISM ON A SAWING MACHINE

When a cut has been completed, the governor shaft, which is equipped at the driving end with a slipping clutch, is rotated in a direction the reverse of that in which it is driven, by means of a handle at the operating end of the machine. This movement has the effect of forcing back the two discs and raising the saw in preparation for the next cut.

The makers state that with this governing mechanism fitted to the machine, no difficulty has been experienced in sawing light window frame sections on the mitre or straight at a speed of 200ft. per minute, using a six-tooth blade, and that by the use of special saw blades entirely satisfactory results have been obtained on cycle tubes and the like. The finish obtained on these very light sections, it is said, is quite as good as that normally obtained by milling, while by reason of the control blade, breakage is done away with. The device is applicable to the whole range of "Rapidor" sawing machines made by the firm.

s.s. Musician and s.s. Recorder: Pulverised Fuel Service Results.

In our issue of March 27th last we published some service results of the steamship "Berwindlea," which were sent on to us by the Berwind White Coal Mining Company of New York. The "Berwindlea" is one of seven ships which are equipped with Resolutor pulverisers, as supplied by Clarke, Chapman and Co., Ltd., of Gateshead-on-Tyne, the other steamers being the two North German Lloyd steamers "Donau" and "Stassfurt," the tugboat "Metz," and the dredger "Bassure de Baas," also the two Harrison Line steamers "Musician" and "Recorder."

By the courtesy of the owners, Messrs. T. and J. Harrison, of Liverpool, we are now able to give representative performance figures for these two last-named ships.

The "Musician" was built in 1919 by Lithgows, Ltd., and engined by Rankin and Blackmore, Ltd., and she has a length of 384·9ft., a beam of 52ft., and a depth of 26·7ft., with a measurement of 4663 gross tons. In April, 1929, she was partially converted for burning pulverised fuel on the Clarke-Chapman system, two of her three hand-fired boilers being equipped for using powdered coal. The boilers are of the single-ended type, with a diameter of 15ft. 6in. and a length of 11ft. 6in. They are designed for a working pressure of 180 lb. per square inch, and the three furnaces are 7ft. 6in. long with an internal diameter of 3ft. 10in., the smoke tubes being 2¾in. external and 2¼in. internal diameter respectively. Steam is supplied to a triple-expansion engine with a designed output of 2700 I.H.P., the cylinders having diameters of 27in., 44in., and 73in. for the H.P., I.P., and L.P. cylinders, with a stroke of 48in.

The two No. 2 Resolutor pulverising units each have an output of 1 ton of coal per hour, and there are six turbulent type Woodeson burners, one to each furnace of the two boilers. The coal is raised to the upper bunkers from the main bunkers by means of a motor-driven elevator, and the pulverisers are also electrically driven, there being two 40-kW Clarke-Chapman generator sets, one of which serves as a standby unit.

The following figures are representative of the performance of the ship since the date of the installation of the powdered fuel plant over two years ago :—

First Voyage on Powdered Fuel (Outward Bound)—Cheap Slack Coal.

Speed	11·0 knots
Consumption, total, including one hand-fired boiler	30 tons per day
Power	2000 I.H.P.
Crediting main engines with all coal	1·4 lb. per I.H.P. hour.

The above passage, when made on three hand-fired boilers, could not be done under 35 tons per day.

Homeward Passage—Mixed Coal.

Speed	10·6 knots
Consumption, including one hand-fired boiler	30·7 tons per day

Round Voyage.

Speed	10·8 knots
Consumption	30·3 tons per day

One passage was made on full power and the consumption of coal with two boilers on powdered coal and one hand-fired was 35 tons per day. When the boilers were all hand-fired, full power could only be obtained on a consumption of 45 tons per day. The figures above referred to show an average saving of 16 per cent. in weight of coal burnt, and an average saving of 35 per cent. in costs.

If the three boilers had been converted to powdered fuel burning, the saving would have been in the neighbourhood of 20 per cent. in weight of coal burnt.

So successful was the performance of the powdered fuel plant on the s.s. "Musician" that T. and J. Harrison, Ltd., had in July, 1930, a cargo vessel of 5887 tons specially built for the Harrison Line in which all the boilers were fired with pulverised fuel on the Clarke-Chapman principle.

This steamship, the "Recorder," has a length of 418·2ft., and is equipped with engines designed to develop 3000 to 4000 I.H.P. The cylinder dimensions are :—H.P. cylinder, 27in.; M.P. cylinder, 46in.; and L.P. cylinder, 77in., with the stroke 54in. Steam is raised in three single-ended powdered fuel fired boilers, 16ft. 3in. by 12ft., the furnaces being 7ft. long and 4ft. in internal diameter, and the smoke tubes having an internal diameter of 3in. The total heating surface is 2400 square feet, and the working pressure 210 lb. per square inch. The three main boilers are each served by one No. 2 Resolutor pulveriser, with the ring main system of distribution to the furnaces, but in this installation the pulverisers are driven by high-speed reciprocating engines of 28 B.H.P. designed output.

The coal elevator is also steam engine driven, so that the generating set does not differ in any respect from that usually employed on similar hand-fired vessels.

The s.s. "Recorder" recently left Liverpool on her third voyage, the twelve months running have been completed on powdered fuel, and the results, the owners hold, have more than justified the venture.

The following figures are typical of each voyage :—

Outward Passage—Cheap Slack Coal.

Weather	High head gales all way
Speed	9·4 knots
Consumption	39·6 tons per day
Power	2407 I.H.P.

Homeward Passage—Mixed Coal.

Weather	Strong beam and quarter winds
Speed	11·4 knots
Consumption	41 tons per day
Power	2990 I.H.P.
Crediting main engines with all coal	1·27 lb. per I.H.P. hour
Deducting 5 tons per day for auxiliaries	1·16 lb. per I.H.P. hour

This vessel, steaming completely on powdered coal, has developed 73 horse-power per ton of coal burnt, against 62 to 65 horse-power per ton of coal burnt by hand-fired sister ships of the same company.

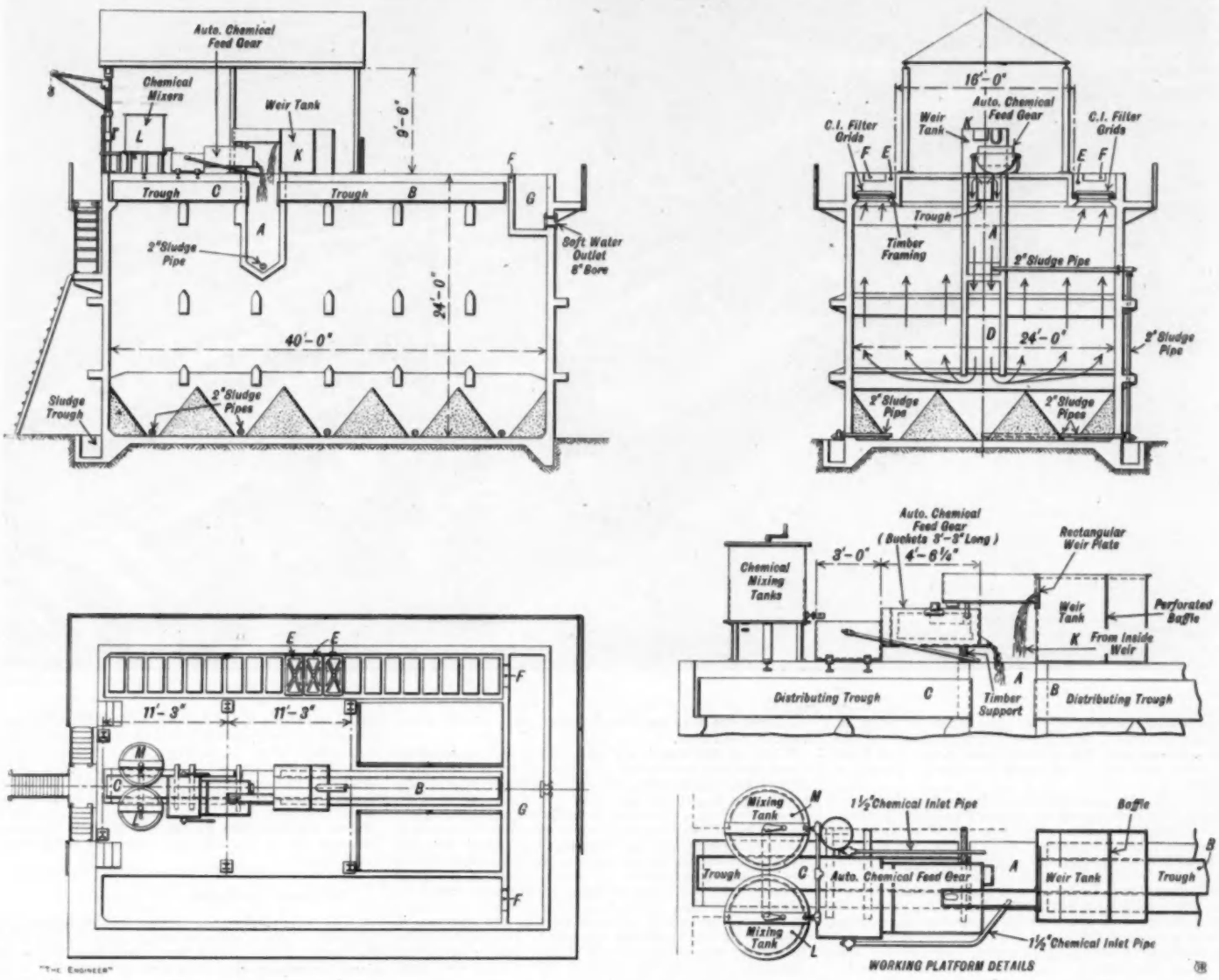
It is interesting to place on record that the firm of Clarke, Chapman and Co., Ltd., has recently received orders for the complete powdered fuel plant for two Japanese cargo and passenger ships. One steamer to be so equipped will be fitted with three single-ended Scotch marine boilers, each with three furnaces. The heating surface of each boiler will be 2850 square feet, and the working steam pressure 225 lb. per square inch. The powdered fuel plant will consist of three Clarke-Chapman Resolutor pulverisers, each designed to deal with approximately 15 cwt. of coal per hour; while each pulveriser will fire one boiler by means of three Woodeson patent turbulent flame burners. The Clarke-Chapman patented ring main system of distribution will be used, with the firm's patented ash ejector plant. An interesting point about this installation is that the pulverisers will be steam engine driven. The other steamer will be equipped with three "Resolutor" pulverisers, each designed to deal with one ton of coal per hour, comprising the pulverising chamber, the separator, the primary air fan and driving engine, which are all included in one unit mounted on the same bed-plate. The drive will be by means of high speed steam engines each with a designed output of 30 H.P. at 1450 revs. per minute with a steam pressure of 100 lbs. per square inch and exhausting against a back pressure of 10 lbs. per square inch. As in the previous mentioned order, the firm's ring main system with short flame burners and complete auxiliary air pipes, elevator, ash ejector plant, crushers, etc. will be used.

The world rights for the manufacture and sale of the "Resolutor" pulveriser, it may be recalled, are divided between Clarke, Chapman and Co., Ltd., of Gateshead, who have equipped and received orders for the equipping of five vessels, Messrs. Fours Stein, of Paris, who have equipped two vessels and the Kohlonstaubfeuerung A.G., of Berlin, which firm has equipped two vessels, making a total of nine in all.

What is described as being a new addition to the "science of the mineral world" has been announced by W. F. Foshag, of the United States National Museum. The material has been named Krausite, and is described as a sulphate of iron and potash of varying sized crystals, usually mauve or yellow in colour, some of the latter having a clear and brilliant lustre. The commercial value of the mineral is not indicated.

WATER SOFTENING PLANT AT NEWTON-LE-WILLOWS

MR. T. ROLAND WOLLASTON, M.I. MECH. E., DESIGNER



Large Water Softening Plant at Newton-le-Willows.

THE accompanying engravings represent a large water-softening plant designed by Mr. T. Roland Wollaston, M.I. Mech. E., of Manchester, and recently installed at the calico printing and finishing works of J. F. and E. Caulfield, Ltd., Newton-le-Willows, Lancashire, which has some features of special interest. The processes carried out at the works involve the use of a very large volume of water. Hitherto the main supply has been drawn from a deep well, a water remarkably free from organic contamination, but carrying considerable temporary hardness, leading to excessive costs for soap, as well as scaling in the boilers and other vessels. Latterly, the supply from the well has been inadequate and has been supplemented from a stream running through an adjoining valley, whence some 36,000 gallons per hour are raised by pumping. This stream water is heavily charged with organic matter, particularly at flood times, and is contaminated in varying degree by effluent from another works upstream. In addition to adding to scale and soap consumption, its use has frequently involved the repetition of scouring processes and the like, to obtain perfect finish of the material.

The water softener is designed to deal with 36,000 gallons of stream water per hour. The water is of a brownish tint and the total hardness varies between 14 deg. and 22 deg. from day to day. The following is a recent analysis :—

	Grains per gallon.
Total solids	23·50
Lime (CaO)	5·97
Magnesia (MgO)	1·98
Silica	0·75
Oxide of iron	0·18
Sulphuric anhydride	3·68
Chlorine	3·68
Free CO_2	1·70
	Deg.
Total hardness	18·72
Temporary hardness	14·45
Permanent hardness	4·27

The water is at present treated with caustic soda; 58½ gallons of caustic soda at 80 deg. T.W. per charge softens 234,000 gallons of water to 3·2 deg. total hardness, giving an effluent so bright and clear that small pebbles can be counted through 10ft. depth of water in the reserve tank, although no sand or quartz filtration is introduced. This remarkable clarification is, no doubt, assisted by the admixture of a small amount of "Alfloc"—a preparation of sodium aluminate. The saving thus effected in soap and the acceleration of process work are said to be remarkable. Up to the present time the boilers have not been opened up for inspection, but it is believed that the effects therein are entirely satisfactory.

The tank is a concrete structure, reinforced in accordance with the system of the British Reinforced Concrete and Engineering Company, Ltd., Stafford, and is proportioned so that, at full output, there is a period for sedimentation approaching 4 hours.

VIEW OF THE WATER-SOFTENING PLANT

By reference to the line engraving, it will be seen that the main tank is provided with a series of steep concrete pyramids at the base, dividing it up into three longitudinal and five transverse channels served by fifteen sludge cocks, so that it is possible to run off and clear accumulated sludge from all parts. The sludge cocks are of special design, whereby, in the event of blockage, they can be immediately cleared.

A fault in some large sedimentation tanks is the prevalence of eddies and short circuits which may arise from numerous causes, even from slight differences of temperature, which frequently neutralise the effect of large capacity in causing local disturbances. It will be noted, in this instance, that special precautions have been taken to render the whole area equally effective.

The water, immediately after treatment, flows into the mixing compartment A, where it is subjected to violent agitation. From thence it flows right and left along the steel channels B and C, from the double sills of which —76ft. total length—it is distributed over the whole length of the mid-partition D and flows downwards nearly to the bottom. It then rises slowly on each side at a rate not exceeding 1¼in. per minute finally passing the filter mats E, E, and the evenness of deposit on these mats is an indication that the aim of the designer has been accomplished. After passing upwards through the filter mats the bright softened water flows over the weirs F, F, to the outlet channel G and away for use.

The filtering arrangement is of the simple description introduced several years ago by the designer of this plant as an alternative to the primitive "wood-wool" filters usually adopted in water softening. There are, in this case, forty light cast iron grids, each measuring 3ft. 10in. by 1ft. 8in., over each of which is roughly sewn a piece of coco matting. These lie and make joint by their own weight upon openings framed with timber. The matting, in its new condition, has little effect, but, after an hour or two, becomes covered with a film of precipitated matter, which, at the slow and even rate of upward flow, is most effective. In course of time, in this case after three or four weeks' work, the accumulated matter offers increased resistance, and the mats tend to bulge upwards. The grids, with their mats, are then lifted out, one by one, and replaced with spares. The fouled mats, on their grids, are put in a warm place, *e.g.*, the boiler-house, to dry, are beaten with a stick, and are ready for replacement. The removal and replacement of a fouled grid is a matter of only a few seconds, and no stoppage is involved if replacements are undertaken systematically, say, four grids per day.

Turning now to the hard-water feeding and proportioning gear, the designer's "oscillating bucket" chemical feed, as described in our issue of April 3rd, 1925, is used. This has been improved in detail by the provision of water-tight and self-lubricating ball bearings and with facilities for the more ready removal of deposited matter. The

THE BEAUHARNOIS POWER-HOUSE UNDER CONSTRUCTION

distinguishing features of this gear are :—(1) Slow and shockless movement, thus preventing spilling and reducing wear and tear, and (2) freedom from contact—and, therefore, from friction—of all parts immersed in water or chemicals.

The method of application in this case is novel. A proportioning gear to pass 36,000 gallons of water per hour, and fulfilling the above conditions, would be large and cumbersome, but the power needed is only the same for this large volume as it would be for one-tenth the amount. The proportioning gear as fitted, therefore, is only the same size as would be fitted to a plant normally to deal with 4000 gallons per hour. The hard water enters the large receiving tank K fitted with a perforated diaphragm or baffle to steady the flow. This tank is provided with two rectangular sharp-edged weirs, respectively 15in. and 1¼in. wide, and set dead level. Obviously, the flow over these weirs will be proportional under all heads. The water from the narrow weir only operates the proportioning gear. That from the wider weir flows directly to the mixing compartment A, where the smaller volume of water with added reagents joins it.

The reagent solution is prepared in the two tanks L and M, each of which holds a supply sufficient for one day's run, so that one mixing per day, at any convenient time during the day, is called for. It will be noted that substantial staging is provided, giving access to all parts, that the operating portion is conveniently housed, and that two light jib cranes are provided for handling chemicals and the filter grids. In view of the constant changes in the water a miniature laboratory is fitted in the super-structure, with simple means for regulating treatment as may be required.

Progress at the Beauharnois Hydro-Electric Power Station.

Active construction work on the power development project at Beauharnois, on the St. Lawrence River, which was begun over two years ago, reached its peak recently. One of the main features of the project, which was described in our issues of February 13th and 20th, 1931—the power house—is rapidly nearing completion, and it is expected that the installation of the first two 50,000 H.P. generators will be begun about the middle of this month. Most of the equipment for these two units will be in place by the end of the year. Preparations for installing the two 8000 H.P. service units, which generators will be used to supply power for plant use, are under way.

In the power-house itself, the erection of the steel work has been nearly finished. Bricklayers have followed close on the heels of the structural steel workers, and the next month or so should see the completion of the unit, as far as outward construction is concerned. The installation of wiring and the complementary equipment which will follow will take several months to complete.

Excavation of the tail race is proceeding, the greater part of rock excavation at the power site having been done. The road diversions and bridge construction rendered necessary by the formation of the canal are also going forward. Three bridges have had to be built, two for the New York Central and one for the Canadian National Railways. All the piers for one of the bridges have been erected and the erection of the steel work will be begun shortly. While that bridge will be for railway traffic only, the other two structures will provide accommodation for rails and a highway. Progress is being made with the sinking of the piers for these bridges ; all are being taken down to solid rock.

Work on the canal and ship channel is proceeding. About half the latter had been dredged by the middle of September, and the big sand suction dredger is gradually working its way down the canal.

As a result of a recent parliamentary investigation into the affairs of the company, the Federal Government is planning to exercise some measure of control over the future conduct of the enterprise. Four possibilities are now open with respect to the management of the great development :—(1) The present management may be able to secure financial backing to enable it to continue ; (2) the property could be taken over by the Province of Quebec ; (3) the Dominion Government might take over the project and operate it as a public utility ; or (4) the company might be reorganised under new conditions prescribed by Act of Parliament so as to ensure the continued progress of the work of the enterprise. The Canadian Prime Minister has intimated that he preferred the last alternative, but there has been no announcement as to what the Government really intends to do. Whatever course is taken will have to be carried out in co-operation with the Quebec Government, which issued the licence for the development.

South African Engineering Notes.

Whaling Industry.

Owing to the enormous quantities of whale oil which the various whaling companies have obtained during recent years, and especially the last three, when the value of the oil obtained has risen by over a million of pounds sterling per year, until in 1930 it reached no less a sum than £9,000,000, there is now a large surplus. This has resulted in most of the whaling companies deciding to do no whaling in the Antarctic next season. As a consequence of this decision a number of ships have returned to Scandinavia, but the companies resolved to retain a number in southern waters. The decision of the companies not to whale this season will mean a loss of over £50,000 to engineering firms here, which have for years been effecting all repairs both to the big factory ships and the small whalers that catch and bring the whales to them. Besides this there is the value of the supplies of coal and stores and the amounts collected for dock dues. In regard to the latter the laying up charges at Union ports amount to £8 10s. per vessel per month, and as the charges at Walvis Bay are less the companies had decided to send their vessels to lay up there, and over thirty have already gone there. Recognising the loss the ports were sustaining, the Union Railway Administration has reduced the charges by 50 per cent. Whether any of those that have gone to South-West Africa will return now cannot be said, but if they do not the loss of the whaling repairs will be a serious blow to the marine engineering industry at Durban and Cape Town, and incidentally to the whole country, apart from the money which whalers spend in the Union for refitting and revictualling when the ships have to be made ready for sea at the end of the close season.

Union Steel Corporation.

The board of the Union Steel Corporation decided to re-start at the beginning of August the manufacture of pig iron at the Newcastle blast-furnace. Owing to the accumulation of stocks, operations were temporarily suspended at the end of January last. Mining has now been resumed at the Prestwick iron ore mine, which had been closed down since April, 1929. This reopening will provide the necessary ore supplies which were previously obtained from surface deposits, but which are now practically exhausted. The Union Steel Corporation has recently acquired a controlling interest in the South African Bolt and Nut Factory, at which it is intended to produce 120 to 130 tons per month of bolts, nuts, and coach screws.

Equipment Purchases.

The market that South Africa offers to manufacturers of plant and machinery is strikingly shown by the fact that the Union purchased from Great Britain alone, in one year, electric motors to the value of £104,500 ; transformers, £81,700 ; dynamos and parts, £719,000 ; boilers, £93,800 ; sugar milling plant, £93,300 ; oil and petrol engines, £80,000 ; pumps and accessories, £87,800 ; cranes, spares and elevating machinery, £87,700 ; corn and flour milling machinery, £68,000 ; printing and bookbinding equipment, £60,000 ; lathes, £56,000 ; and miscellaneous machinery and parts, £336,000. Similar plant to a considerable value is, however, also imported from other manufacturing countries.

Union Mineral Production.

According to the Department of Mines monthly abstract for June, the Union's mineral production for the first six months of the year—exclusive of diamonds—represented a total value of £25,139,774. That is £144,340 higher than the figure returned for the corresponding period of 1930, but when it is noted that gold production was responsible for an increase of £437,420 this year as compared with the first half of 1930, and platinum production this year is £74,190 higher, it will be evident that other minerals must have shown an appreciable falling off. For example, the value of the output of coal was lower by no less than £263,105.

New Engine Shop at Mafeking.

The South African Railways and Harbour Administration is busily engaged at present on behalf of the Rhodesian Railways in work on a large engine erecting shop, with its subsidiary services, at Mafeking. The structure is of the "saw tooth" type with five bays, and the shop will cover an area of 16,500 square feet. Particular attention has been devoted to the provision of ample lighting and ventilation, which will be afforded by windows in the roof and the sides of the building. Modern plant and equipment are being installed throughout, including a travelling crane, saw mill and planing machines, with the usual lathes and other essential fittings and erecting equipment.

Railway Revenue.

The revenue of the Union of South Africa Railways for the week ended August 30th fell from £439,062 in the previous week to £431,020. The total revenue to the end of that month from April 1st, 1931, was £9,413,872, compared with £10,208,163 for the corresponding period of last year. Further retrenchment and economies are taking place. All workshops will be closed on Saturday mornings until further notice. The short working on Fridays in the mechanical workshops, which was instituted some time back, will continue to be regulated by the amount of work available.

Rand Water Supply.

The increasing demand for water on the Witwatersrand has brought about the necessity of extending the Vaal River scheme, and the proposed extensions will be put in hand forthwith at a cost of £179,500. It is intended to increase the present supply of ten million gallons a day by a further five million gallons. For this purpose, apart from the additional pumping and purification plant incidental thereto, one of the two existing pipe lines is to be increased from a capacity of five million gallons a day to a capacity of ten million gallons. The present main is composed of 70,000ft. of 22in. diameter steel pipe between Vereeniging and Witkop, and 70,000ft. of 24in. diameter steel pipe between Witkop and Zwartkopjes. It is proposed to replace the length of 22in. piping by steel pipes 31in. in diameter and to re-lay the 22in. diameter piping so released, and re-covered, alongside the existing section of 24in. diameter steel pipes between Witkop and Zwartkopjes. The two sections—22in. and 24in. diameter pipes—will be connected with the new 31in. diameter pipe line from Vereeniging. The cost of the works included in this extension scheme are estimated by the chief engineer to be as follows:—Additional plant to be installed at Vereeniging pumping station: pumping plant, £23,500; boiler plant, £7000; sedimentation tanks, £13,000; filters, £12,000; pipe connections and alterations, £2000. Pipe line: 70,000ft. 31in. diameter steel pipe line from Vereeniging to Witkop, £97,000; 70,000ft. 22in. diameter steel piping to be lifted, cleaned, painted and relaid between Witkop and Zwartkopjes, £18,000; total engineering expenses, £172,500; interest, &c., estimated to bring the total up to £179,500.

Electrical Development.

The Chairman of the Electricity Supply Commission, Dr. van der Bijl, recently detailed the progress of the Commission, particularly in Natal. The Durban load, he stated, was growing so rapidly that the Commission was putting in at Congella a 12,000 H.P. turbine and two boilers, the biggest in Africa, with a capacity of 120,000 lb. of steam per hour. The capital of the Electricity Supply Commission is now over £8,000,000, and its revenue £1,000,000 per annum, while its total generating capacity is 227,000 kW, or 300,000 horse-power. The total number of units of electricity sold last year amounted to nearly 900,000,000, of which roughly 100,000,000 were supplied to the Durban Corporation. The Commission now supplies current to every town in Natal along the railway line from Newcastle to Durban, taking in Glencoe, Ladysmith, Colenso, Estcourt, Mooi River, Nottingham Road, Maritzburg, and Cedara. The Howick Rubber Factory and smaller centres are connected with the Commission's supply.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Little Market Movement.

In the Midlands and Staffordshire business has been quiet this week, and there has been little movement in the iron and steel market in Birmingham. The election is, no doubt, to some extent responsible for the lack of interest. It is fairly certain that many consumers have already covered their known requirements some little time ahead, and they are not inclined to speculate on the future. The bright tone of the market is maintained and the recent expansion in raw iron business keeps up. There has been no notable change in iron and steel values on the week, though market adjustments have taken place here and there. Producers of material, engineers and manufacturers in this area are preparing for the future, but caution is still exercised. They have confidence that prospects will improve very shortly. Stocks of material have been allowed to dwindle almost to nothingness, and, now that business seems to be on the mend, users desire to replenish them. Producers are not so anxious for business as they were, however. They are waiting to see how the country settles down and to visualise as clearly as possible the future trend of business and of prices.

Raw Iron.

Blast-furnacemen in the Midlands have further strengthened their position and in many instances order books have a better appearance than has been the case for many months past. Not only so, but specifications for delivery have improved, showing that there is at least some expansion of consumptive demand. Inquiries in the ironfoundry trade are encouraging and an improvement in activity in some branches has taken place. Midland smelters are evidently counting upon a continuance and growth of this activity in the consuming industries, hence the recent decisions to extend production. Furnacemen in this area are not affected to the same extent as those on the North-East Coast by the changed competitive conditions of British and foreign iron brought about by the depreciation of sterling. Very little iron is exported from this area, the cost of carriage to the ports being sufficiently heavy to render it uncompetitive. As foreign iron for similar reasons does not come into this district, there is nothing to be gained in the shape of local orders. A larger consumption of iron in the forges and foundries and mills in the near future is, however, anticipated, and there is a growing confidence in the prosperity of the industry. Prices of pig iron are unchanged at £3 2s. 6d. for Northamptonshire No. 3 foundry, and £3 6s. for Derbyshire and North Staffordshire. Forge grades sell at 5s. per ton less in each instance. The quotation is for delivery to Black Country stations.

Steel.

Nothing has occurred to stimulate business in the heavy steel industry, and the position shows little change, apart from somewhat firmer quotations for small bars and mild steel billets. The engineering industries throughout the Midlands, with the exception of the automobile industry, do not show definite signs of revival, and their material requirements are not large. Trade in structural material is poor. Engineers find contracts difficult to secure. The industry has suffered a severe decline this year, and postponement of development work has clouded the outlook for the remainder of the year. The Steel Masters' Association maintain prices of controlled material at recent levels. In the half-products department the position is brighter, for here and there is some diversion of business from the foreigner to British makers. Native producers have so strengthened their position that, this week, they were pressing for an advance on selling rates. For small bars re-rolled from foreign material, they ask up to £7 per ton, though all the business transacted was not at such a satisfactory figure. For all-British bars the selling price ranged from £7 15s. upwards, while soft billets were very firm at £5 5s. to £5 10s. Continental quotations in Birmingham this week were fairly steady; billets, however, were uncertain, prices ranging from £4 12s. 3d. to £4 17s. 6d. Sheet bars were named £4 15s., and Belgian steel bars £5 4s. Merchants were very cautious and little business was done.

Staffordshire Bar Iron.

There has been no change in the conditions ruling in the Staffordshire finished iron trade, and business this week has been very much a repetition of that of last week. Small tonnage orders have come in with fair regularity for best grade bars, the price of which is maintained at £12 per ton at makers' works. In the Crown bar section trade is very dull and competition for the small orders which come on to the market is keen. Makers from other districts offer supplies at rates below those acceptable to Staffordshire ironmasters. Quotations vary between £9 5s. and £10 5s. There are few, if any, local works which would accept the lower figure. Nut and bolt and fencing iron is slow of sale, the figure of £8 7s. 6d. required for iron made in this area being very far in advance of that quoted by continental firms. Most of the orders, it is regretted, go abroad. The call for wrought iron tube strip keeps up well, and order books in this department of the market are fairly substantial. The price now generally named is £10 12s. 6d. per ton delivered, but it is still possible to get orders accepted at £10 10s. provided they are for substantial quantities.

Galvanised Sheets.

Business in galvanised sheets has declined further, and many mills have reduced their quotation for overseas business to £9 12s. 6d. per ton for 24-gauge galvanised corrugateds. A few transactions have been put through this week at that figure, but, while the position of local mills is better than it has been, orders are becoming increasingly necessary if plants are to be kept in operation. The home trade is a little brighter and demand from that quarter is assisting manufacturers. For this business £9 15s. is the general quotation for 24-gauge. Other departments of the market are quiet.

Tube Works Closing Temporarily.

Owing to depression in the shipbuilding industry and a general falling off of orders, the Weldless Steel Tube Works, Wednesfield, near Wolverhampton, which are associated with Tubes Ltd., are to be closed down temporarily within the next week or so. For months past, not more than half the usual number of hands has been employed, and many of those for only four days a week. The company was a pioneer in this country in the manufacture of this kind of tube, the works at first being situated in Birmingham. They are equipped with the most modern plant.

Stamping Works Dividend.

The balance sheet of Thomas Smith's Stamping Works, Ltd., Birmingham, reflects the adverse conditions under which business has been conducted during the past year. For the past eight years the company has paid a consistent 10 per cent. dividend, but this year it is only in a position to pay one of 5 per cent. The company in the past have never hesitated to make improvements in plant and organisation, and it has built up reserves which have enabled it to face the very considerable difficulties of the past working year.

Heavy Edge Tools.

The improvement in business in the heavy edge tool industry in this district recently noted, has been maintained, and works are certainly better placed than they have been for many months past. The aggregate of work on hand is not, however, very considerable, having regard to the volume of business normally done in the Midlands in this line. The increase of business, such as it is, is very acceptable and leads to hope of better times. Works have had a long period of very meagre business, and there are, even at date, thousands of idle hands, many of whom have not been employed for from six to twelve months. The Cannock area, according to report, has benefited more than either Wednesbury or Wolverhampton by the recent welcome orders.

Pit-head Baths.

Modern pit-head baths have been erected by the Miners' Welfare Committee at the Earl of Dudley's Baggeridge Colliery, near Dudley, and they are now available for use. The building, which has cost approximately £15,000, has accommodation for 1176 men. There are ninety-six cubicles, each equipped with a shower spray, with a control for hot, tepid and cold water. The cubicles are of white tiles. There are also boot-cleaning and greasing apparatus, drinking water fountains, special taps at which water flasks can be filled, a canteen, a first-aid room and a cycle shed.

Steel Contract.

Included in the orders just given out by the Great Western Railway Company is one for steel girders and other steel and ironwork to the Patent Shaft and Axletree Company, Ltd., of Wednesbury.

Swedish Works for Birmingham.

A report emanating from Sweden has it that plans are under way to establish branch factories in Birmingham, to be associated with the Stenmac Cutlery Works at Eskilstuna, for the manufacture of hinges and other iron goods used in building. A British firm is said to be interested in the venture, but up to the present I have been unable to identify this firm. The source of the information is, however, usually reliable.

Unemployment.

A substantial decrease in the number of persons unemployed in the Midlands is recorded again this week, the total having fallen by 7420 on the week. The present total of 380,670 is higher by 90,027 than in the corresponding week last year. The districts in which increases have taken place are Cradley Heath, Stoke-on-Trent, Stourbridge and Brierley Hill, Wednesbury, Worcester and Kidderminster. In the Birmingham area the total of 71,324 compares with 73,369 a week ago. Coventry and Wolverhampton figures are both slightly down.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Hope for the North.

LANCASHIRE has never been seriously perturbed by the occasional announcements of the transfer of various branches of industry from the north to the south, certainly not to the extent of becoming panicky regarding the prospect of the movement developing into a regular trek. To compensate in some degree for the losses in the one direction, other industries have been attracted to Lancashire, and largely to the Trafford Park area of Manchester, which may fitly be described as the hub of the modern engineering industry in the county. The possibilities of more newcomers to the industrial field are not remote, although in that respect much will depend upon the trend of political events. Last week-end witnessed unusual activity in the Trafford Park district, when a party of business men came by air to the city for the purpose of inspecting industrial sites along the Ship Canal. Numerous inquiries are being dealt with from the United States and the Continent, as well as from British firms not already domiciled here. The nature of the industries concerned in the inquiries has not been disclosed, but there is official confidence that, in the event of certain political and economic developments, the Manchester district's transport facilities and relatively low power costs will prove a powerful industrial magnet.

Another Electrification Scheme?

Following closely on the completion of the electrification of the Manchester–Altrincham railway line, comes the news that the London, Midland and Scottish Company may proceed in the near future with the electrification of the lines from London-road Station, Manchester, to Macclesfield and Chelford, a distance of 17 miles in each case, at a total estimated cost of about £1,000,000. It is understood that much will depend upon the attitude of the North-Western Traffic Commissioners, when, early next year, they come to consider road transport fares. If reasonable protection is afforded in this respect, the London, Midland and Scottish Company will, it is expected, be prepared to start the work of electrification. Both of the lines in question carry heavy suburban traffic to and from Manchester. A further point of local interest is the possibility that the company will provide a station at Besses-o'-th'-Barn, midway between Prestwich and Whitefield, on the Manchester–Bury electrified line.

Reduction of Capital.

Sir Courthope Wilson, K.C., the Vice-Chancellor, in the Manchester Chancery Court on Monday, confirmed the reduction of capital of Simon-Carves, Ltd., of Manchester and Cheadle Heath, from £400,000 to £286,325. It was explained that the company was originally incorporated in 1896 as the Simon-Carves Bye-product Coke Oven Construction and Working Company, Ltd., with a capital of £100,000, which was increased in 1907 to £400,000, the company adopting its present title in 1916. Large profits had been earned by the company, the balance sheet taken on December 31st, 1930, showing assets valued at £667,132, of which £61,000 was invested in subsidiary concerns and £266,908 in other investments. By repayments to shareholders out of the proceeds of certain investments or cash at the bank, it is proposed to reduce the capital to the amount stated.

Addition to Order Books.

Henry Simon, Ltd., Cheadle Heath, has secured an order for a travelling pneumatic grain discharging plant for Messrs. Weaver and Co., Swansea. The plant will have a grain-discharging capacity of 180 tons an hour.

Non-ferrous Metals.

After the general reaction in the non-ferrous metals markets recorded a week ago, values seem to have become more or less stabilised for the time being. At all events, there has been very little change on balance in any section. The fact that British users of tin have been coming on the market for somewhat better tonnages has had little influence on the general situation, for consumers in the United States as well as on the Continent are showing little or no increase in buying interest. There is, however, a tendency in some quarters to take a more hopeful view of the outlook. During the week tin prices have moved up and down, but, at the moment of writing, values are above the worst, and have finished up almost exactly where they were a week ago. Interest in copper has shown

a certain amount of expansion on all sides, and the market has derived some "lullish" support from the negotiations proceeding in the United States, with a view to bringing supply and demand into closer agreement. Under this influence, quotations moved up at one time, but reaction left prices of standard brands at about 5s. a ton above the parities of a week ago. Although there has only been a relatively quiet business done in lead, supplies of the metal in sight are not excessive, and quotations have been maintained. Spelter also has kept steady, and in this case a fair demand from home users has been reported, with, however, foreign buyers taking only very moderate quantities.

Iron and Steel.

The lull in foundry iron buying on the Lancashire market continues, and additions to the tonnage on makers' books have been small. Unless something untoward develops there will be little need for any general resumption of buying for a month or two, in view of the quantities of pig iron to which local users are already committed. General foundries, in particular, are not specifying as freely as producers would like, but in several other directions the tonnage going into consumption represents an improvement. Values are maintained at 67s. per ton, delivered equal to Manchester, for Derbyshire, Staffordshire, and Cleveland iron, 65s. 6d. for Northamptonshire, about 87s. for Scottish, and 81s. for West Coast hematite. In the steel market there has been additional inquiry about for the delivery of miscellaneous descriptions over the next two months, and a certain amount of actual business done. That, however, does not seem to represent any improvement in the position of the principal heavy branches of engineering, and is regarded more generally as a precautionary measure against a rise. Fair quantities of alloy steels are being taken up against the orders placed recently. Boiler plates are quoted at up to £8 17s. 6d. per ton, tank plates at £8 17s. 6d., joists at £8 15s., and sections at £8 7s. 6d.

BARROW-IN-FURNESS.

Hematite.

The general improved tone in the hematite pig iron trade is maintained. Makers have experienced a run of orders better than has obtained for many months, and at last the demand has overtaken the output, with the result that the stocks which had accumulated in the district are now coming down. Up to the present, the reduction is to the extent of over a third. As regards the clearance of stocks, it is interesting to note that the better qualities of iron are in biggest demand. Ordinary qualities are at the moment inclined to drag. With a continued demand on local steel account reductions will be rapid. Home business is the feature, and although there is an improvement in business with the Continent, the fall in sterling has not up to the present attracted the amount of buying that some expected. This side of trade may develop. There is the interesting news this week of the absorption of the North Lonsdale Ironworks at Ulverston and Cleator Moor by the virile Millom and Askam Company. This has been on the tapis for some time, but at last the news is definite. Iron ore is better, and a cargo of Spanish ore has arrived for Ulverston, a fact which suggests that the works there will start producing again in the early future. The steel market remains dull. Barrow holds orders which will keep the works going for some weeks, and Workington has contracts that will keep it engaged three weeks a month for three months or so. Workington is engaged on South African contracts. The fall of the pound has, it is reported, helped the hoop works, which are busier.

SHEFFIELD.

(From our own Correspondent.)

Situation Improving.

THE last few weeks have seen an improvement in the conditions of the steel industry, and although it is still far from being set firmly on its feet again, the progress so far made is a welcome sign, and inspires a feeling of confidence with regard to the future. The advance to be reported relates principally to the production of basic open-hearth steel. At the Templeborough works of the United Steel Companies the number of furnaces in operation has been increased to eight, each of which produces approximately 1000 tons per week. Conditions are also somewhat better at the same firm's Stocksbridge works, while at Masborough it has two furnaces engaged in the manufacture of acid open-hearth steel, as against one only a few weeks ago. At the works of the Park Gate Iron and Steel Company two more furnaces were gassed last week, bringing up the total to five. The rolling mills also are working better. Some improvement is also reported in North Lincolnshire. All this progress is, of course, only relative to the serious state of slackness which has prevailed for some considerable time. The plants are still working much below capacity. The production of acid steel shows little growth. The cost of this material is likely to be increased as a result of the fall in the value of our pound, as the greater part of the hematite ore required for its production has to be imported from Spain and Morocco.

Scrap and Alloys.

The future is regarded with a fair amount of confidence by scrap merchants. The market has maintained its recent increase of strength, and basic scrap is now worth 40s. per ton. There have been increased deliveries of this material, and also of cast iron scrap, although actual consumption has not risen much so far. There are no increases in the quotations for controlled steel material to record. Importers of Swedish material are in no hurry to raise their prices to local consumers until stocks are exhausted, but it is expected that there will be a rise of 20 per cent. before long, even in the absence of Customs tariffs. The advances of 4d. per pound in tungsten and molybdenum are still in force, and most of the ferro-alloys are costing about 20 per cent. more than previously, but these quotations may be regarded to some extent as nominal.

The Manufacturing Side.

The heavy engineering branches have not yet participated in the improved conditions. The scarcity of work in the shipbuilding and railway steel departments is still very pronounced. British railway companies have now been pursuing an economical policy for a long time, but it is understood that this is to be modified, as the companies are now short of vehicles and stocks, and will soon find it essential to increase their specifications. The firm of George Turton, Platts and Co., Ltd., one of the specialities of which is railway buffers, did not do so well last year as in the previous year, although it was still able to pay a dividend of 3½ per cent. At the annual meeting, the chairman reported that in the first half of the year they had large orders for all their manufactures, but in the second half buying fell off entirely, and they did not know where to look for work. Competition became terrible, and people were now taking orders at any price. The railway companies had suspended their building programmes, with the result that they had no orders to place, and that was extending to India and South America. He announced that the firm had got an order to supply buffers to 500 new wagons. That would mean about 2000 buffers, and would provide partial work for the winter. He added that the directors had had a proposal put up to them to go into Russian work, but they shuddered at the idea. The special manufacturing branches which produce stainless steel and kindred materials are well employed, while the call for automobile requirements is on a substantial scale, though not up to the normal. Some firms in the lighter steel branches report better order books and numerous inquiries. The exports of steel from Sheffield to the United States during the quarter ended September were of the value of £12,000, as compared with £13,000 in the preceding three months.

A Fine Rolling Feat.

A notable exhibition of what Sheffield is capable of was afforded last week by the way in which a rush order for 375 tons of steel bar was dealt with by the United Strip and Bar Mills, Ltd. The order was received on Tuesday morning, the mill commenced work on it at 11.20 a.m. the same day, and by 11.10 p.m. the rolling was completed. By 1.40 a.m. on Wednesday the whole of the material had been inspected, tested and loaded. The tonnage represented 74 miles of steel bar, or nearly 400,000ft. The L.M.S. Railway Company also had a share in the expeditious execution of the order. It received the material for transit at 1.10 a.m. on Wednesday. A special train was at once made up, and the steel was despatched at 1.54, reaching its destination, 76 miles distant, at 5.40. Some of the material was actually delivered at 8 o'clock in the morning.

Government Orders.

A number of Sheffield and district firms is participating in the latest allocation of work by Government Departments. To the Admiralty, shafting—both intermediate and propeller—is to be supplied by William Jessop and Sons, Ltd., Thos. Firth and John Brown, Ltd. The War Office is taking bullet-proof plates from Hadfields, Ltd., round steel from S. Fox and Co., Ltd., and high-speed steel from Jonas and Colver (Novo), Ltd. Hadfields are also to supply bombs to the Air Ministry, for which the Blackburn Aeroplane and Motor Company, Ltd., of Brough, is to carry out aircraft repairs. The Crown Agents for the Colonies have ordered hydrants from Guest and Chrimes, Ltd., of Rotherham, and tubes from Howell and Co., Ltd., of Sheffield. Heating appliances are to be supplied by A. Grindrod and Co., of Sheffield, to the Shrewsbury Sorting Office, to the order of H.M. Office of Works.

Orders and New Works.

Richard Dunston, Ltd., of Thorne, has received orders for two of the largest sized lighters used at the port of Hull. The vessels will be capable of carrying over 1000 quarters of wheat from the incoming steamers to the mills. At the Cornwall Works of Friese-Greene, Nicholson and Co., Ltd., Sheffield, a new industry has been started in the manufacture of "interchangeable tubular standard-type" seats for use in cinemas, offices and cafés. The seats are made of tubular steel, and are not only exceptionally strong, but are built up of a number of standard parts, and so can be easily taken down or assembled. It has been officially stated that, if the new Parliament adopts a tariff, a large foreign firm of artificial silk manufacturers will, in all probability, erect large works on the Colwick Park estate, Nottingham, to employ 3000 people.

Cutlery and Plate.

There is some improvement to report in these branches. The home demand is rather better, and further progress is expected now the General Election is over. In consequence of the depreciation in the value of sterling, foreign competition in scissors, pocket-knives and several other kinds of cutlery, as well as tools, shows a falling off. There is not much difference now between German and English prices, and, as a result, business is being diverted from Germany to local firms. These trades are largely dependent upon countries abroad for their raw materials, prices of which have gone up by 20 to 25 per cent. At present, dealers have not raised their selling prices, as they hold stocks bought at old rates, but a continuance of the present rates of exchange will mean dearer cutlery, plate and tools in the future. There is increased activity in the safety razor blade branch. The difference in price between Sheffield and German blades has been greatly reduced, or even obliterated, by the rate of exchange. This relates especially to the cheaper qualities, and I understand that the German blade retailing at 1d. is now off the market. Brooks, Haywood and Co., Ltd., one of the latest Sheffield firms of razor blade manufacturers, have booked an order for South America for two millions of their "Robin Hood" blade, which retails at 1½d. The Admiralty has placed contracts for electro-plate with Fenton Bros., Ltd., and Joseph Rodgers and Sons, Ltd., of Sheffield. Exports of cutlery to the United States during the quarter ended September 30th showed an improvement, amounting in value to £3000, as compared with £2100 in the previous quarter. The increase was chiefly in safety razor blades, which went up from £1150 to £1800.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

POLITICAL excitement has been too intense to permit of much business in the Cleveland iron trade this week, but the confident tone is undiminished, and the belief is general that trade is on the threshold of a period of expansion. Producers are not pressing iron on the market. They have sold as heavily as they care to do at rates now ruling, and hope to obtain rather higher terms for further sales, particularly as costs have increased. Pig iron shipments from the Tees this month show a substantial increase, but the home demand continues to absorb the bulk of the output. Moreover, although there are still heavy stocks, a big proportion of these has now been sold, and it is anticipated that output will soon have to be increased. Prices are firm and unchanged, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

East Coast hematite pig iron makers are well sold, but they are still prepared to dispose of their stocks on the basis of 65s. This figure, however, only applies to deliveries a month or two ahead, and beyond that date higher prices are asked. The two hematite furnaces at the Normanby Ironworks of Pease and Partners, which have been on slack blast, are once more going at full pressure.

Iron-making Materials.

Sellers have advanced quotations for foreign ore by quite 3s. per ton, but consumers are still fairly well supplied, and continue to hold off the market. Best Rubio ore is put at 17s. 6d. c.i.f. Tees. Good medium blast-furnace coke is firm at 17s. 6d. delivered at the works.

Manufactured Iron and Steel.

There are strong hopes of a revival in the manufactured iron and steel trade. Many inquiries are circulating, and it is believed that substantial business will be released when the political situation becomes more settled. Prices are not quotably changed.

The Coal Trade.

Most sections of the Northern coal trade are no more than steady, although the collieries have a good number of orders to go on with and quote the late range of prices. New business, however, is coming along slowly. Inquiries from abroad have fallen off, and at home there are signs that buyers are well supplied for the moment. The advent of much colder weather than has been experienced of late will increase domestic and other consumption, and pits may continue to work regularly. An important contract placed this week is that of the Midi Railways of France for 100,000 tons of Durham coking coal, to be shipped in monthly quantities over twelve months, commencing in March, 1932. It is understood that prices are based on the present fixed minimum. The quantity taken is only about half the companies' usual requirements from this country, a result, possibly, of the French import restrictions. The Northumberland steam coal position is quiet, but there are hopes of more trade when the excitement of the General Election is over. Best Blyth steams are more easily obtainable for early delivery than they were a few weeks ago, as in second hands they offer at 13s. 6d. to 13s. 9d., while the direct price is 14s. For next week and onwards business is needed to absorb the current volume of production, and operators are anxious to clear their holdings. Steam smalls are plentiful, with millions of tons on the ground in Northumberland and few buyers at the minimum of 8s. to 9s. Wear primes are quiet and offer freely at 15s. for large and 12s. for small. The Durham position generally shows a poor trade. Producers of gas coal are not receiving the average inquiry for the time of the year, but the season has not yet fairly begun. Best gas coal is pressed on the market at 14s. 6d. to 14s. 9d., with secondary qualities at 13s. 3d. to 13s. 6d. Coking coals are plentiful at the old figures, and bunkers are without feature, bests being in fair request for steamers' direct use. The demand for gas coke is maintained, and with moderate stocks available for the next two months, prices are indicated firmly at 19s. for best kinds. Patent oven coke is plentiful, tending easier in tone at 17s., superior qualities being 18s. to 21s.

French Import Restrictions.

Further restrictions on exports of coal to France are causing some anxiety in the North of England coal trade. With a 25 per cent. cut in the November quantity, as compared with September, the loss of trade to this country is likely to be considerable. Northumberland and Durham supply all classes of coal to France, and they will suffer a proportionate share of the reduction. Countries other than our own which export coal to France have supplied "certificates of origin," and something of the same kind is to be introduced for the United Kingdom. Instead of our exporters securing import licences from French authorities, it is proposed that district coalowners' organisations, acting under the direction of the Central Council in London, should issue the permits. North of England exporters are opposed to this plan, as they believe it will be impracticable. One reason why the exporters in this district are opposing the transference of the permits from French authorities to the coalowners' organisations is that it will leave them less latitude in the blending of coking coal. These blends have been specialised in by the

exporters to suit the needs of customers, and the constituent parts are bought from different collieries. If the collieries are given the powers of issuing licences through the Central Council in London, the new system tends, it is argued, to interfere with this old-established blending system by compelling exporters to place orders with one or other of the collieries instead of buying, as in the past, with full freedom as to blends.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding Prospects.

Though recent developments cannot be likened to the commencement of a boom, the outlook has certainly been improved during the past few months in several districts, and inquiries for new tonnage are increasing. In the Port-Glasgow area the outlook has improved considerably by the placing of another order with Lithgow's Ltd., for a 9000 tons cargo vessel on behalf of C. and J. Harrison, Ltd., London. This will be the third vessel which Lithgow's Ltd., have on hand for the same owners. Lobnitz and Co., Ltd., Renfrew, have received an order for a rock-cutter boat for foreign owners, the building of which will entail a considerable amount of work.

Steel.

There is no appreciable change in the Scottish steel trade, notwithstanding the depreciation of sterling, but hopes are entertained that business will improve after the General Election is over. Meanwhile the works engaged on the production of heavy steel are poorly employed. The demand for sheets, especially of the lighter variety, has improved, however, and there are strong hopes of renewed business with the Far East. Tubes, also, show an improving tendency, with an expanding inquiry. Prices are unchanged from last week.

Iron.

Makers of wrought iron have a fair number of orders for skelp for shipment to Canada, but business otherwise is without development. Re-rolled steel bars have appreciated to £6 10s. per ton, home and export, owing to dearer raw materials, and makers find great difficulty in securing new business.

Pig Iron.

It is expected that the output of pig iron in Scotland will be increased, but, up to date, there has been no move in that respect apart from the restarting of two furnaces in order to provide supplies for associated steel works. Though local prices have been reduced, considerable quantities continue to arrive in this district, the latest consignment, which was unloaded last week, amounting to 1600 tons.

Scrap.

The feature of the scrap market has been the substantial rise in the price of cast iron machinery, which now shows a further advance to 52s. 6d. per ton. Heavy steel remains at last week's quotation of 40s. per ton.

Coals.

The recent improved inquiry for Scottish fuel for export has not been maintained. Exporters are now handicapped by the advance in price at the collieries of the qualities chiefly in request, and by renewed competition from Polish coal. Contracting over a period is practically impossible, and prompt business is shrinking. Lanarkshire splints are affected by reduced demands from Italy and South America, and industrial conditions affect the demand for other sorts. Fifeshire steams have a steady turnover, and Lothians steams have benefited from improved household demands. In all districts, but especially in Fifeshire, treble nuts are a firm spot, but double nuts can now be obtained through second hands slightly below colliery quotations. Single nuts are uneven and smaller sizes become more plentiful. Aggregate shipments for the past week amounted to 255,745 tons, against 246,632 tons in the preceding week, and 206,111 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

Business has been rather overshadowed by the political situation, though the coal trade has not been without its points of interest. Shipments of coal and coke last week were, in all the circumstances, well maintained, inasmuch as the total for the ports in this area under the control of the Great Western Railway Company came to 453,065 tons, which compares with 453,330 tons for the preceding week. As a matter of fact, the total for last week is appreciably above the average for previous weeks this year, and for once in a way it was better than the quantity shipped during the corresponding period of 1930, though it should be said that that particular week was the lowest total for any week of last year. For prompt loading business has quietened down—that is, so far as steam coals are concerned—and it is quite possible that there may be somewhat of a lull for a time, but so far as anthracite coals, they are exceptionally busy, and some qualities are booked up to the end of the year. At the end of last week there were actually six steamers waiting to berth, which indicates the activity prevailing, but at the other ports in this area the number of idle tipping appliances stood at thirty, and as the result of arrivals of tonnage over the week-end, the total was only reduced to twenty-four. The position of steam coal undertakings is variable indeed, as, while one hears of a resumption of work at some pits, it has to be noted unfortunately that at one or two others, notices have been served upon the workmen to terminate their contracts, while at a fair number of collieries work is very intermittent. Coal contract operations continue to claim a considerable amount of attention. Reference was made last week to the fact that the order for 80,000 tons of steam coal for the Brazilian Central Railways had come to this district, and since then Mr. H. H. Merrett, the managing director of Gueret, Llewellyn and Merrett, Ltd., of Cardiff, has stated that developments in other directions, include the fact that full cargoes of Welsh coal are now being sent to Monte Video for a large electrical power station which has just been brought into operation, whereas previously Welsh coal was only sent out in small quantities. He also referred to reciprocal trade with Finland, pointing out that as the result of orders being placed by this country for pit props, pulp wood, and pulp, the Finnish Government had decided to purchase the whole of its coal requirements from this country instead of Poland. Orders had already been placed for 36,000 tons of English and Welsh coal, mainly the former, to be delivered this year, and active negotiations were in progress for the supply of several hundred thousands of tons, to be delivered over 1932. As part of the reciprocal arrangements, 50,000 tons of Finnish props had been bought for use in the Welsh mines. Tenders went in last week-end for the coal requirements of the Portuguese State Railways, and were opened on Monday, but so far no news has come to hand, as to the definite placing of the business, though it is confidently expected that any purchases made will be for Welsh coal.

Coal Inquiry.

The Midi Railways of France, who are reported to have purchased 100,000 tons of Durham coals, are now in the market for 50,000 tons of Welsh large coals on an f.o.b. basis, with delivery from February to December.

France and Coal Imports.

Perhaps the worst news concerning the coal trade is the intimation that France is cutting down still further her imports of coal and coke. Up to the present time France has permitted imports based on the average for 1928, 1929, and 1930, less 20 per cent., but as from the beginning of November there is to be another 5 per cent. reduction, thus making the figure 25 per cent. less than the average quantities imported in the three years mentioned above. This, of course, is not good news, more especially as returns show that since the operation of the licensing system this country appears to have suffered relatively a greater reduction than other countries, and, as a consequence, it is reported that it is extremely likely that a change will be made in the administration of licences. Instead of these being dealt with by the agents in France of the coal-exporting firms in this country, it is proposed that this country should be placed on the same basis as Germany, Holland, Poland, and Belgium, whose central colliery-owners' associations administer the licences. This means that the administration is transferred from France to this side, and is placed in the hands of the British Central Coal Council. Coal exporters in South Wales have had a meeting to consider this new development, and their directors have had a meeting with the coalowners' representatives in order to discuss the situation, but no report has been issued as to the result of their deliberations. If the change in the administration of the licensing system means that this country will get her fair share of the business with France, then there can be no complaint.

Trade Development.

Efforts are being made by the authorities at all the leading towns in this area to develop trade. In the movement to form a development association, to take the place of the Development Committee of the City Council, the Finance Committee of the Cardiff Corporation, has recommended the former body to contribute a pound for every pound contributed by other organisations, firms, &c. The Council of the Cardiff Chamber of Commerce has unanimously decided to support the proposal. It is now reported that the British (Guest, Keen, Baldwins) Iron and Steel Company, Ltd., are definitely bringing into operations one of their blast-furnaces at Cardiff shortly instead of resuming operations at Briton Ferry, as mentioned last week. The Mayor of Merthyr is appealing for subscriptions towards covering administrative expenses in promoting Merthyr's scheme for establishing a weldless tube industry on the site of the old Cyfarthfa Ironworks. It is stated that the sum of £100,000 is required to complete the first unit of the proposed works. Arrangements have been made for the reopening on Monday next of the Ashburnham Tin-plate Works, at Burry Port, and the Kidwelly Tin-plate Works, whereby employment will be found for about 1000 men. There is a prospect of the Dafen Sheet Works, which have been closed down all this year, resuming shortly, while at the Bynea Steel Works it is proposed to restart next week two more furnaces, bringing the total in commission up to the full complement of six. Reports are current that additional plant at the bar rolling mills at Messrs. Richard Thomas and Co.'s South Wales Steel Works, Llanelly, is to be restarted so as to secure an increased output. Early in the New Year the new plant at the Rhoose Cement Works will be ready to start, and will mean employment for 100 men at least.

Tin-platers' Bonus.

The latest ascertainment in the South Wales tin-plate trade, which governs the bonus sliding scale of tin-plate workers, shows that the net selling price has reached a point at which all the benefits under the scale have been eliminated. The ascertainment is that for the quarter ending September 30th, and under it wages of tin-plate workers will be in accordance with the base rates. Lower-paid men receive an *ex-gratia* bonus, which is subject to periodical renewal.

G.W.R. Company: Schemes Abandoned.

The decision of the directors of the Great Western Railway Company to abandon the schemes for a new lock entrance at Swansea, and the extension of the pier at Port Talbot, has come as a shock to the commercial community in South Wales. Although there appears to be very little hope of the directors revising their decision, there is no doubt that steps will be taken to endeavour to persuade them to do so. The South Wales Coal Shipment Advisory Committee, meeting at Cardiff, has already had the matter under consideration, and has unanimously decided to protest against the action of the company, and a deputation has been appointed to interview Mr. Milne.

Current Business.

The tone of the market is at the moment quiet and very little fresh business is passing. The situation of collieries varies considerably. Dry coals are very steady and find a ready outlet, but other descriptions of steam coals are not too well placed for orders. Patent fuel and coke display no material change, while pitwood is easier at 25s. to 25s. 3d.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Institution of Chemical Engineers has appointed Mr. H. W. Cremer, M.Sc., F.I.C., to be Honorary Secretary of the Institution in the place of the late Professor J. W. Hinchley.

Guest, Keen and Nettlefolds, Ltd., Newport, Mon., ask us to announce that Mr. Cadby, who has been their Midlands representative for a great many years, retired on September 30th, and that Mr. C. A. Parson, 111, New-street, Birmingham, has been appointed in his place.

Mr. Fred W. Davies, the Electrical Maintenance Works, Huddersfield, informs us that his son, Ronald K. Davies, has joined him in partnership, that the business is being carried on as Fred. W. Davies and Son, and that the works have been transferred to Longroyd Bridge, Huddersfield.

CONTRACTS.

Richard Dunston, Ltd., shipbuilders, of Thorne, Yorkshire, has received an order to build two steel lighters for service at Hull. The vessels are to be of the following dimensions, 75ft. by 20ft. by 9ft. 6in., and will be the largest size of lighter used in the Port of Hull. Each is to be capable of carrying over 1000 quarters of wheat from the incoming steamers to the mills.

K. L. Kalis Sons and Co., Ltd., of Stone House, Bishopsgate, London, E.C. 2, have signed a contract with the London and North-Eastern Railway Company for carrying out dredging work in connection with Parkeston Quay extensions, Harwich. The dredgings will be utilised to reclaim a marshy area belonging to the railway company and adjacent to the dredging site. The work will be begun at an early date.

The Ash Company (London), Ltd., of 63, Lincoln's Inn-fields, W.C. 2, has obtained an order for the supply of a complete "Hydrojet" ash and dust-handling equipment for the new Orated power station of the Copenhagen Municipality. The equipment is for use in connection with eight 100,000 lb. per hour stoker-fired boilers, and each boiler will be provided with a special refractory-lined cast iron hopper in which the ash will be stored and quenched.

The Great Western Railway Company announces that the following orders to the value of £119,600, including big works at Paddington and Cardiff in connection with the rebuilding schemes at those stations, have recently been placed:—(*a*) Extension of Westbourne Terrace Bridge and other works at Paddington Station, Halliday and Greenwood, Ltd., London, S.W. 1; (*b*) alterations to heating apparatus at Paddington Passenger Station, Baker, Perkins, Ltd., London; (*c*) supply and erection of one electric 15 cwt. passenger lift at the new offices at Paddington Station, the Titan Lift Company, Ltd., London, N.W. 1; (*d*) construction of new subway at Cardiff General Station, A. Jackaman and Son, Ltd., Slough; (*e*) supply and erection of material for extension of overhead contact line, Queen Alexandra Dock, Cardiff, Callender's Cable and Construction Company, Ltd., London, W.C. 2; (*f*) the supply of steel work for a footbridge in Canton Yard, near Cardiff General Station, Rees and Kirby, Ltd., Morriston; (*g*) supply and erection of two 3-ton electric service portal level-luffing jib cranes and grabs at Riverside Wharf, Brentford Docks, Cowans, Sheldon and Co., Ltd., Carlisle; (*h*) supply and erection at Port Talbot Docks of one horizontal compound condensing hydraulic pumping engine, East Ferry Road Engineering Works Company, Ltd., Millwall, E. 14; (*i*) supply and erection of roof and side sheeting at the Stafford Road Works, Wolverhampton, Wolverhampton Corrugated Iron Company, Ltd., Ellesmere Port, Cheshire; (*j*) construction of bridges and other works east of Cardiff General Station, Caffin and Co., Ltd., London, W.C.; (*k*) supply of four Ford vehicles, fitted with three-way hydraulic tipping bodies, Car Mart, Ltd., London, N.W. 1; (*l*) construction of platform shelters and other works at Horfield and Ashley Hill stations, C. A. Hayes and Sons, Bristol; (*m*) supply and erection of two reinforced concrete water tanks at Sully and North Side power stations, Barry Docks, John Perkins and Son, Ltd., Bristol; (*n*) supply of steel girders and other steel and ironwork, Patent Shaft and Axletree Company, Ltd., Wednesbury; (*o*) the removal of a portion of an old wall and the rebuilding of a retaining wall and other work at Adelphi Wharf, Waterford, Richard B. Nolan, Waterford; (*p*) supply and erection of two electric 3-ton goods lifts at Taunton Goods Shed, Keighley Electric Engineering Company, Ltd., Keighley; and (*q*) erection of office and stores buildings at Worcester signal and telegraph depot, Haughton Bros., Worcester.

Faraday House Dinner.—The annual dinner of the Faraday House Old Students' Association was held at the Savoy Hotel on Friday evening last, October 23rd. Nearly 300 members and guests attended under the chairmanship of Mr. G. R. J. Parkinson. Captain Donaldson, the President of the Institution of Electrical Engineers, proposed the toast of "Faraday House and its Old Students," and Dr. Russell, the Principal, responded. He mentioned the good work done by old students during the past year, and emphasised the notable public service done by Clifford Paterson. Referring to the good work done by Faradians in all branches of engineering, he said that one of them who had just left College had invented a new valve amplifier, which was now used in several of the leading London theatres. An old student, F. S. Smythe, had attained the summit of the highest mountain ever climbed by man; while two students had obtained doctorates and one a professorship of Physics. Mr. S. B. Haslam proposed the toast of "The Guests," and Sir John Brooke and Sir Robert Robertson responded. "The Chairman" was proposed by Mr. S. P. Doudney.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	16/– to 20/6
(1) Spanish	16/– to 18/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	17/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 6 0	3 6 0
No. 1	3 6 6	3 6 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
Midlands—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
,, ,, Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*) / 4 0 6 (*b*) / 4 5 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 10 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
Lancs.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. Yorks.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
Midlands—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates (Marine)	9 0 0	8 10 0
,, ,, (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ⅛in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	11 0 0	10 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
,, ,, (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
Manchester—		
Bars (Round)	9 7 6	—
,, (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	8 15 0 to 8 17 6	—
Sheffield—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
Midlands—		
Small Rolled Bars	6 17 6 to 8 0 0	—
Billets and Sheet Bars	5 5 0 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 12 6 to 10 0 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 17 6	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14 f.o.b.	14/– to 14/6
Block Tin (cash)	127 2 6
,, (three months)	129 15 0
Copper (cash)	35 18 9
,, (three months)	36 13 9
Spanish Lead (cash)	13 7 6
,, ,, (three months)	13 6 3
Spelter (cash)	13 0 0
,, (three months)	13 6 3
Manchester—	
Copper, Best Selected Ingots	41 10 0
,, Electrolytic	42 15 0
,, Strong Sheets	75 0 0
,, Tubes (Basis Price), lb.	0 0 10¾
Brass Tubes (Basis Price), lb.	0 0 9¾
,, Condenser, lb.	0 1 0
Lead, English	15 2 6
,, Foreign	13 12 6
Spelter	13 12 6
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/4 per lb.	
Ferro Tungsten	2/– per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	7/–
,, ,, 6 p.c. to 8 p.c.	£24 0 0	7/–
,, ,, 8 p.c. to 10 p.c.	£22 10 0	6/6
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£35 0 0	10/–
,, ,, ,, 1 p.c. carbon	£39 0 0	12/–
,, ,, ,, 0·70 p.c. carbon	£41 0 0	13/–
,, ,, ,, carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
,, ,, ,,	£11 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£10 10 to £12 scale	5/– per unit
,, ,, 75 p.c.	£16 to £17 scale	7/– per unit
,, Vanadium	12/9 per lb.	
,, Molybdenum	4/2 per lb.	
,, Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£210	
Ferro Cobalt	8/6 per lb.	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	14/6
,, ,, Splint	14/3 to 15/6
,, ,, Trebles	14/– to 14/6
,, ,, Doubles	13/–
,, ,, Singles	10/–
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	17/–
,, ,, Trebles	15/–
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 13/6
Screened Navigation	17/–
Trebles	16/6 to 18/6
Doubles	13/6 to 14/6
Singles	10/–
Lothians—	
(f.o.b. Leith)—Best Steam	12/6
Secondary Steam	12/–
Trebles	15/6 to 16/–
Doubles	13/6
Singles	10/–

(8) N.W. Coast— ENGLAND.

	Export.
Steams	21/–
Household	32/6 to 51/8
Coke	20/– to 20/6
Northumberland—	
Best Steams	14/– to 14/3
Second Steams	12/– to 12/3
Steam Smalls	8/6
Unscreened	12/6 to 13/–
Household	27/– to 39/–
Durham—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/– to 37/–
Foundry Coke	24/–

Sheffield—	Inland.	Export.
Best Hand-picked Branch	24/6 to 25/6	—
South Yorkshire Best	23/6 to 24/6	—
Derbyshire Best Bright House	21/– to 22/–	—
Best House Coal	21/6 to 22/6	—
Screened House Coal	19/– to 20/–	—
Best Screened Nuts	18/– to 19/–	—
Small Screened Nuts	16/6 to 17/6	—
Yorkshire Hards	17/– to 18/6	—
Derbyshire Hards	17/– to 18/6	—
Rough Slacks	9/6 to 10/6	—
Nutty Slacks	7/6 to 8/6	—
Smalls	5/6 to 6/6	—

Blast-furnace Coke (Inland) .. 10/6 on rail at ovens
Furnace and Foundry Coke (Export), f.o.b., 16/– to 16/6

(9) SOUTH WALES.

	Export.
Cardiff—	
Steam Coals :	
Best Smokeless Large	19/6 to 20/–
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	18/– to 24/–
No. 3 Rhondda Large	19/9 to 20/–
,, ,, Smalls	15/– to 16/–
No. 2 ,, Large	17/– to 17/3
,, ,, Through	15/6 to 16/–
,, ,, Smalls	14/– to 14/3
Foundry Coke (Export)	22/– to 36/6
Furnace Coke (Export)	15/6 to 16/–
Patent Fuel	19/– to 19/9
Pitwood (ex ship)	25/– to 25/3
Swansea—	
Anthracite Coals :	
Best Big Vein Large	36/– to 38/6
Seconds	27/– to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/– to 48/6
Beans	28/6 to 32/6
Peas	21/– to 22/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/–
Steam Coals :	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from associated British Steel Makers. Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Quotations in Sterling.

THE belief that the depreciation of the pound would have eliminated British currency as a standard of international values in favour of the franc is not justified by the transactions which are taking place on the Brussels 'Change, where iron and steel for export are still quoted in sterling and reduced to actual values, while quotations are often made in paper pounds. This shows that there is nothing that offers a sufficient guarantee of permanent stability to replace sterling, and it also indicates foreign confidence in the future of the pound, which, whether stabilised at a lower level or on the former basis, will continue to be an international unit of currency. There are already signs that business is only wanting a successful British reconstruction to revive, but meanwhile it is completely disorganised, and in France coalowners fear that they will have to shut down pits, while the Government has prepared a programme of relief works at a cost of 3000 million francs, including 600 millions for roads, 500 millions for harbour works, 50 millions for inland waterways and 150 millions for civil aviation.

Colonial Railways.

The first International and Inter-Colonial Transport Congress held last week at the Colonial Exhibition in Paris dealt with the three main questions of the Trans-Saharan Railway, the unification of French colonial railways and the necessity of connecting them up internationally in a way to provide an economical distribution of African products. The Trans-Saharan Railway was the subject of a communication by Monsieur Maître-Devallon, General Inspector of Colonial Works, who said that the railway would be easy to construct and was indispensable as a means of providing communication between North Africa and West Africa, where the population was large and the possibilities of traffic were enormous. The colonial railways must, he urged, be of standard gauge, as experience had shown that the efficiency of metre-gauge lines was limited to a distance of 1000 miles and to an annual traffic of 300,000 tons each way. The inquiry carried out for the Trans-Saharan Railway indicated that a normal gauge line could carry several million tons a year at a cost varying from 10 centimes to 50 centimes per ton per kilometre. Other reports criticised the French policy of railway construction in Africa, which had taken into account immediate requirements without reference to future developments. Monsieur Beau, of the Colonial Section of the Public Works Department, said that the 5000 miles of good roads in Oubangui-Chari were unproductive because there was no outlet to the sea, while enterprise in the Niger valley was stagnant because communications were made with the south instead of with the consuming centres in the north. The creation of 37,000 miles of motor roads in French West Africa had the effect of draining traffic from the railways instead of bringing traffic to them, as would inevitably be the case if there were some organised collaboration between the two methods of transport. On the whole, the discussions showed that the French are not satisfied with the results of the considerable efforts they have made to open up the African territories, that feeling being due to the fact that the different colonies have been influenced by local interests, while in railway construction they have been guided by a desire to do things as cheaply as possible, a policy which has proved extremely wasteful in the long run. Some of the metre-gauge lines were so lightly built that they could not stand the traffic, and had to be reconstructed. Amongst the 39,000 miles of railway working throughout Africa there are six different gauges ranging from 60 cm. to the standard gauge, though most of them are 1 m. and 1·06 m. gauges. That is a serious matter for builders of rolling stock, and Monsieur Ribot, representing the builders' association, inquired whether it would not be possible to adapt the same rolling stock with wheels adjustable to the two gauges. The whole matter, he said, was one that should be dealt with internationally by experts. So far as the French colonies are concerned, means of communication have been created without any definite general plan and the results have been, in most cases, unsatisfactory, but experience has shown the necessity of adopting a plan of reconstruction and a rational connecting up of the different systems and that, in the minds of the Trans-Saharan Railway protagonists, would necessarily lead to the diversion of traffic across the Sahara desert. All this work will concentrate into one vast enterprise that cannot be undertaken at present without assistance, which the French are looking for from Germany. They refuse to relinquish reparations in kind, and the negotiations now in hand aim at securing from Germany some of the material required for the construction of colonial railways, the Trans-Saharan Railway, ports and other works.

Electrical Organisation.

About a year ago the northern part of Paris was deprived of electric light by a short circuit and fire at the Saint-Ouen power station, and, in order to avoid such inconvenience in the future, arrangements were made to connect up the sources of supply so that they could offer mutual assistance in cases of emergency. The work is well advanced, and though not completed, the arrangement is already giving good results, as was shown last week when a fire at the Issy-Les-Moulineaux station of the Compagnie Parisienne de Distribution d'Electricité caused the interruption of the lighting service in the southern part of the city. The power stations of the Union d'Electricité and the hydro-electric supply from Eguzon were able to connect up with the southern mains in less than an hour and a-half.

Warm Water Energy—A Correction.

In your issue of Oct. 9th I reported a conference held at the Sorbonne, at which the Claude-Boucherot system of power generation from the sea was described. In that report I stated that the construction of the pipe would account for about one-half the total cost of construction. Monsieur Georges Claude informs me that this figure should be, not one-half, but about eleven per cent.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

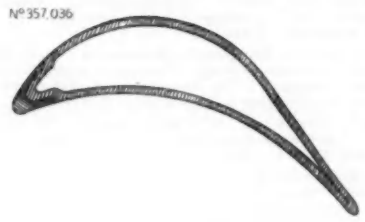
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TURBINE MACHINERY.

357,036. January 5th, 1931.—STEAM TURBINE BLADES, International General Electric Company, Incorporated, 120, Broadway, New York, U.S.A.

Here is a hollow steam turbine blade, pressed from a tube of light material, with the object of reducing centrifugal stresses with a reinforced entry edge of hard material. It is claimed that the material of the tube need only be selected with regard to the

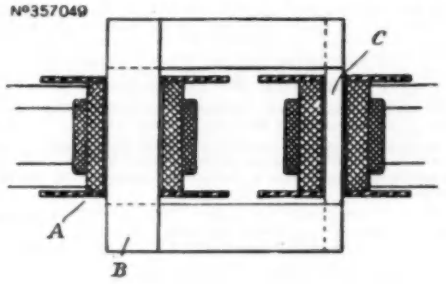


slight stresses acting on the sides of the blade and may consequently be cheap, or, in the case of particularly good material, the tube wall may be kept extremely thin. The fitted edge, on the other hand, should be made of specially resisting material, in which case care must, of course, be taken that the resisting quality of the material is not reduced to any great extent by the heating set up during the welding or soldering.—*September 17th*, 1931.

TELEGRAPHS AND TELEPHONES.

357,049. January 23rd, 1931.—ELECTRIC IMPULSE TRANSFORMERS, *Standard Telephones and Cables, Ltd., Columbia House, Aldwych, London, W.C. 2.*

This invention might be described as a means of converting a "drawled out" message in telephonic transmission into one with a staccatto character. It involves the use of a transformer in which the primary windings A are arranged around a substantial core B of permaloy. The magnetic circuit is completed

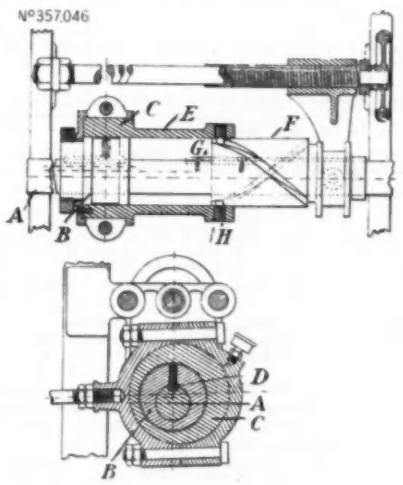


by a comparatively light core C around which the secondary winding is arranged. One of the windings, A, is supplied with a continuous current which saturates the magnetic field, while the other carries the current to be detected by the secondary winding. The core C and its windings do not respond immediately to slow variations in the flux in the core B, as it is already saturated, but when the contra-flux overcomes that of the continuous circuit, a sharp signal is recorded.—*September 17th*, 1931.

TRANSMISSION OF POWER.

357,046. January 20th, 1931.—A COMPOUND EXCENTRIC MECHANISM, G. C. Cooper, 45, Summerlands-avenue, Acton, London, W. 3.

This mechanism is intended for such purposes as driving a

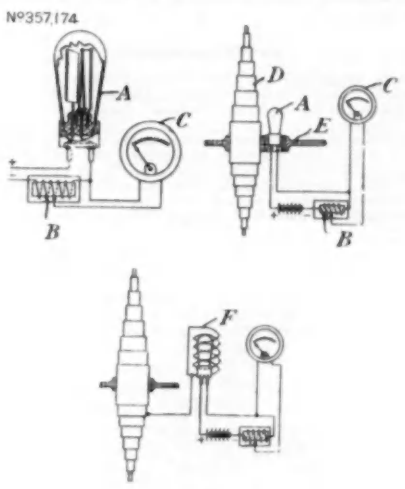


jigging screen, where a variable stroke is required, and is said to be more simple than that generally employed. It comprises two excentrics mounted one over the other on the driving shaft A. These excentrics are shown at B and C, while the strap is marked D. The excentric C has a hollow extension E inside which another excentric F, corresponding to B, can slide on the feather G. On its periphery there are cut helical grooves, which engage studs H. If this piece is moved endways by the gear shown, the outer excentric rotates on the inner one, and the length of the stroke is altered.—*September 17th*, 1931.

MEASURING AND TESTING INSTRUMENTS.

357,174. June 13th, 1930.—ARRANGEMENTS FOR MEASURING ELECTRICAL POTENTIAL DIFFERENCES OR FUNCTIONING IN ACCORDANCE THEREWITH, *Associated Electrical Industries, Ltd., of Bush House, Aldwych, Westminster.*

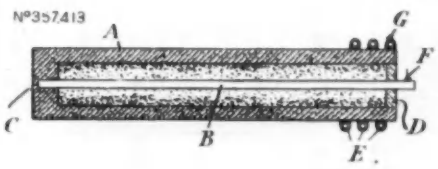
This invention relates to arrangements for measuring the potential difference between two electrical conductors "or functioning in accordance with such potential differences." A is a two-electrode electrical discharge tube having a filament or cathode and an open plate or anode. One of the terminals of the filament is connected through a winding of an auto-transformer B to the negative terminal of a source of energy, such as a battery, and the terminal of the plate is connected to the positive terminal of the source or battery. The winding serves as the primary of the transformer B, the secondary of which, comprising one-half of the main winding, being connected to a control device C, that may be an indicating meter, a relay or a synchroscope, but which is shown by way of example as a voltmeter. The two-electrode discharge tube may be influenced directly by the



electrostatic field produced by the voltage between a condenser bushing D and a container E, in which the condenser bushing is mounted, by placing the tube A in the static field itself, as shown. With this arrangement the electrostatic field set up in the neighbourhood of the bushing will act directly through the walls of the tube upon the electron stream between the electrodes. Alternatively, the tube may be placed in the electrostatic field set up by the electrostatic grid F which is connected to the layer of the condenser bushing. As in the previous case, the electrostatic field acts through the walls of the tube on the electron stream. The application of an electrostatic field to the electron stream from the filament to the plate causes an alternating current component in the plate circuit, including the winding of a transformer B, which causes the voltmeter C to indicate. The transformer prevents the direct current of the plate circuit from affecting the voltmeter C. Another scheme described involves the use of a three-electrode tube.—*September 14th*, 1931.

357,413. November 11th, 1930.—THERMO-COUPLES FOR USE IN MEASURING TEMPERATURES, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

The thermo-couple described in this specification is suitable for high temperatures, and is claimed to have a long life and uniform resistance. The tube A is formed of graphite and is one element of the thermo-couple. This graphite tube receives at one end a tantalum carbide element which constitutes the other element and may take the form of a wire B. The end C constitutes the hot junction. The tantalum carbide wire is spaced from the walls of the graphite tube and it may be held in place by an insulating plug D, which may be formed of any inert insulating material, such as zirconia or thoria. When the thermo-couple is of a relatively small length the cold junction may be kept cool by means of several turns of copper tubing E through which a



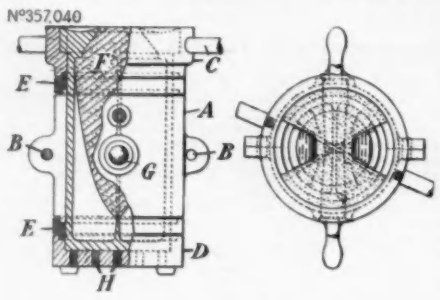
cooling fluid such as water is circulated. Where the length of the thermo-couple is such that there is no danger of the cold end becoming heated, this copper tubing arrangement may be dispensed with. If it is used, however, contact may be made to the graphite through the copper tubing and contact with the tantalum carbide wire is made at F. These contacts F and G may be connected by means of flexible leads to any suitable measuring instrument such as a millivolt meter or a potentiometer. A thermo-couple of the type described was found to develop an E.M.F. of approximately 1 millivolt per 100 deg. Cent. difference. A temperature of about 2000 deg. Cent. as checked by an optical pyrometer was recorded, although it is not the maximum temperature at which the thermo-couple may be used. At that temperature the tantalum carbide was not affected, nor was there any indication of sag in the length used.—*September 24th*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

357,040. January 9th, 1931.—THE CASTING OF PISTONS, A. M. Brown, 98, Fordwych-road, Brondesbury, London, N.W. 2.

This invention is concerned with the process of casting aluminium pistons for internal combustion engines. The mould is made in four principal parts—the two halves of the body A, with lugs and register pins B B, a top annular part C and a bottom D. There may be also intermediate rings E E, which will serve for extending the length of the piston. The interior

form is determined by the sand core F. "Brushes" G are inserted in the gudgeon pin bosses and, presumably, help to ventilate the core, while holes H are bored in the bottom and filled with bundles of wire for the same purpose. It is stipulated

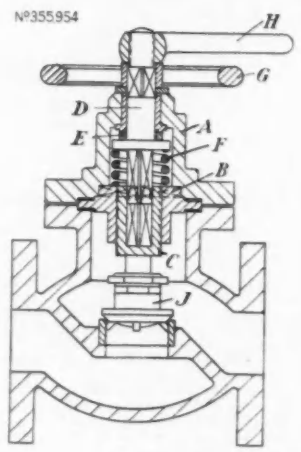


that the mould should be preheated to about 400 deg. to 450 deg. Cent. at the top, from 300 deg. to 350 deg. Cent. in the body, and from 50 deg. to 100 deg. Cent. at the bottom, while the metal is poured at from 650 deg. to 670 deg. Cent.—*September 17th*, 1931.

MISCELLANEOUS.

355,954. September 1st, 1930.—Valve without a Stuffing-box, Wilhelm Martin Christian Lüders, of Barthels and Lüders, of No. 31, Norderelbstrasse, Steinwarder, Hamburg, Germany.

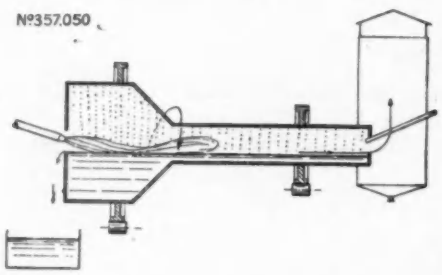
According to this invention between the casing and the top part A of the valve, an intermediate internally screwed part B, or nut member is provided, having a square for preventing the intermediate part from turning, when the valve is being operated. The spindle C has a male thread and a square hole at the point where the spindle D engages. This spindle is provided



with a collar, on which the ring E rests. Between the collar of the spindle D and the intermediate part or nut member B, a spiral spring F is arranged. The hand wheel G is intended for turning the spindle C and the lever H, for tightening the ring. When opening the valve the lever H is loosened and the hand wheel G turned. Then, the spindle D, which engages in the spindle C with its square, rotates and thus raises the cone J. The spring F presses against the collar of the spindle D and thereby clamps the ring E on the seat of the upper part A. The lever H is then screwed down, thus tightening the ring E, so that the valve is tight.—*September 3rd*, 1931.

357,050. January 24th, 1931.—The Evaporation of Liquids in Films, Chemische Fabrik Budenheim Aktiengesellschaft, Mainz, Germany.

A device for the concentration by evaporation of such materials as crude phosphoric acid, by the direct contact of the heating flame. It is pointed out that with the usual arrangement of a rotary dryer the surfaces of the dryer become encrusted with precipitated solid material, and the efficiency of evaporation is materially reduced. As a consequence, the inventors make



the rotary dryer of two very distinct diameters, as shown in the drawing, into the larger of which the flame, say, of powdered coal, is projected. The gases of combustion pass up the tube to escape at the end where the crude solution is introduced. The concentrated solution trickles over the lip of the front end of the dryer into a receptacle below, while any condensate from the waste gases is collected at the bottom of a stack at the outlet. It is claimed that the large capacity of the dryer at the firing end prevents the deposit of accumulations and minimises injury to the lining.—*September 17th*, 1931.

Institution of Naval Architects: Awards.—The Council of the Institution of Naval Architects has made the following awards: Vickers Armstrong Scholarship in Naval Architecture (1931) to Mr. Leonard Redshaw, of Messrs. Vickers-Armstrongs, Ltd., Barrow-in-Furness. The Scholarship is of the value of £150 per annum, and will be held at Liverpool University for three years, and the Duke of Northumberland Prize (in connection with the 1931 examinations for National Higher Certificates in Naval Architecture) to Mr. James Irwin, of the Royal Technical College, Glasgow.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Illuminating Engineering Society.—At the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. Discussion entitled "Some Impressions of the I.I.C. Flood-lighting," opened by Mr. Percy Good. 6.30 p.m.

Institution of Chemical Engineers.—In the Lecture Theatre of the Institution of Civil Engineers, Great George-street, S.W. 1. "Hydrogenation," by Dr. E. F. Armstrong, F.R.S. 6.30 p.m.

Institution of Electrical Engineers: London Students' Section.—Victoria Embankment, W.C. 2. "The Business of Electrical Apparatus Manufacture," by Mr. G. J. Shaw and Mr. G. A. M. Hyde. 6.15 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Informal meeting. Discussion on "Engineering in Agriculture," to be introduced by Mr. R. Borlase Matthews. 7 p.m.

Institution of Mechanical Engineers: East Midland Branch.—University College, University Park, Nottingham. Chairman's address, "The Importance of Metallurgy to the Engineer," by Professor C. H. Bulleid. 6.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Automatic Combustion Control," by Mr. S. J. Clifton. 7.30 p.m.

Manchester Association of Engineers.—At the Engineers' Club, Albert-square, Manchester. Discussion, "The Ageing of Steam Boilers," opened by Mr. W. Ingham; "Superheated *versus* Saturated Steam for Heating Purposes," opened by Dr. T. B. Morley. 7.15 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—In the Mining Institute, Newcastle-upon-Tyne. "The Effect of Immersion on Propellers," by Mrs. E. M. Smith-Keary and the staff of the Yarrow Tank. 6 p.m.

SATURDAY, OCTOBER 31st.

Co-ordinating Committee Representing Staffordshire Iron and Steel Institute, Birmingham Metallurgical Society (Inc.), and Birmingham Local Section of the Institute of Metals.—In the Warwick and Dudley Rooms, Queen's Hotel, Birmingham. Annual dinner and dance. 7 p.m.

Hull Association of Engineers.—In the Municipal Technical College, Hull. "Combustion and Boiler-house Efficiency," by Mr. J. N. Waite. 7.15 p.m.

Institution of Electrical Engineers: North-Eastern Students' Section.—Visit to Automatic Telephone Exchange, Telephone House, Carliol-square, Newcastle-upon-Tyne. 2.30 p.m.

Institution of Production Engineers.—Grand Hotel, Birmingham. Annual dinner. 7 p.m, for 7.30 p.m.

North of England Institute of Mining and Mechanical Engineers.—In the Lecture Hall of the Institute, Newcastle-upon-Tyne. Presidential address, Mr. W. Cochran-Carr. Paper, "The Hydrogenation of Coal," by Dr. A. Crawford. 2.30 p.m.

MONDAY, NOVEMBER 2nd.

Bradford Engineering Society.—Technical College, Bradford. "Ford Production Methods," by Mr. T. Gorst. 7.30 p.m.

National Institute of Industrial Psychology.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Recent Research into the Causes of Industrial Accidents," by Mr. Eric Farmer. 6 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. General meeting. 5 p.m.

Society of Chemical Industry.—In the Chemical Society's Rooms, Burlington House, W. 1. "The Saccharification of Wood," by Dr. H. A. Auden and Dr. W. P. Joshua. 8 p.m.

Wolverhampton and District Engineering Society.—Victoria Hotel, Wolverhampton. "Blast-furnaces," by Mr. S. Trollope. 7.30 p.m.

TUESDAY, NOVEMBER 3rd.

Co-ordinating Committee Representing Staffordshire Iron and Steel Institute, Birmingham Metallurgical Society (Inc.), and Birmingham Local Section of the Institute of Metals.—At the Girls' High School, Dudley. "Architectural and Decorative Ironwork," by Mr. C. A. L. Roberts. 7 p.m.

Institution of Automobile Engineers.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.45 p.m.

Institution of Civil Engineers.—Great George-street, Westminster, S.W. 1. Presidential address, Sir Cyril R. S. Kirkpatrick. Presentation of medals awarded by the Council. 6 p.m.

Institution of Electrical Engineers: South Midland Students' Section.—At the Birmingham University, Edmund-street, Birmingham. "Long-distance Telephony of To-day," by Mr. L. S. Crutch. 7 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow, C. 2. "Oil Tanker Construction," by Mr. E. F. Spanner. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, W. 1. "Combustion of Gases," by Mr. G. I. Finch. 5.15 p.m.

WEDNESDAY, NOVEMBER 4th.

Institution of Electrical Engineers: Wireless Section.—Savoy-place, Victoria Embankment, London, W.C. 2. Chairman's address, by Colonel A. S. Angwin, D.S.O. 6 p.m.

Institution of Engineering Inspection.—Annual dinner postponed.

Institution of Heating and Ventilating Engineers.—At Swedenborg Hall, 20, Hart-street, Bloomsbury, W.C. 1. "Recent Developments in Cooking Apparatus," by Mr. Stanley J. Benham. 7 p.m.

Institution of Structural Engineers: Yorkshire Branch.—Hotel Metropole, Leeds. "Modern Development in Steel and Concrete Piling," by Mr. S. Packshaw. 7 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Chairman's address, "British Research Work in India, in the Fields of History, Archæology, Philology, and Ethnology," by Sir Edward A. Gait. 8.30 p.m.

THURSDAY, NOVEMBER 5th.

Diesel Engine Users Association.—Caxton Hall, Westminster, S.W. 1. "The Elimination of Vibration," by Mr. R. B. Grey. 3.30 p.m.

Institution of Automobile Engineers.—Merchant Venturers' Technical College, Bristol. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7 p.m.

Institution of Civil Engineers: Birmingham and District Association.—At the Midland Institute, Birmingham. "The Construction of the Reinforced Concrete Bridge Over the Mouth of the River Elorn between Brest and Plougastel, in Brittany," by Mr. T. J. Gueritte. 6 p.m.

Institution of Electrical Engineers.—Savoy-place, Victoria Embankment, W.C. 2. Mr. H. Marryat will make a presentation to the Institution of an oil painting of the late Dr. S. Z. de Ferranti, F.R.S. Paper, "Coil Ignition Systems," by Mr. E. A. Watson. 6 p.m.

Royal Aeronautical Society.—In the Lecture Hall of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Safety in Spinning," by Mr. H. B. Irving and Mr. A. V. Stephens. 6.30 p.m.

FRIDAY, NOVEMBER 6th.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, S.W. 1. Thomas Hawksley Lecture, "The Mechanical Aspects of Electricity," by Mr. Llewellyn B. Atkinson. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "The Cooling of the Crude Oil Engine," by Mr. A. P. Quarrell. 7.30 p.m.

Railway Club.—57, Fetter-lane, London, E.C. 4. "The Callender and Oban Railway," by Mr. H. A. Vallance. 7.30 p.m.

SATURDAY, NOVEMBER 7th.

Institution of Mechanical Engineers: Graduates' Section.—Storey's-gate, St. James's Park, Westminster, S.W. 1. Debate, "That a College Education is Desirable in the Training of a Mechanical Engineer." 6.45 p.m.

MONDAY, NOVEMBER 9th.

Institute of Metals: Scottish Local Section.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Experiences with some Electric Furnaces for Melting Copper and Copper Alloys," by Mr. W. L. Govier. 7.30 p.m.

Institute of Transport.—At the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. Annual general meeting. Paper, "The Influence of Transport on Regional Planning," by Mr. J. Paterson. 5.30 p.m.

National Institute of Industrial Psychology.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Recent Research into the Causes of Industrial Accidents," by Mr. Eric Farmer. 6 p.m.

Royal Aeronautical Society.—In the Gaumont Film Company's Theatre, Film House, Wardour-street, W. 1. "Aeroplanes as an Aid to Mineral Exploration and the Operation of Aircraft in Sub-zero Temperatures," by Captain W. J. McDonough, of Canada. 6.30 p.m.

TUESDAY, NOVEMBER 10th.

Institute of Metals: North-East Coast Local Section.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Die Casting," by Mr. A. H. Mundey. 7.30 p.m.

Institute of Metals: Swansea Local Section.—At the Y.M.C.A., Swansea. "Some Causes of Unsoundness in Non-ferrous Alloys," by Professor D. Hanson. 6.15 p.m.

Institution of Automobile Engineers.—King's Head Hotel, Coventry. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.30 p.m.

Institution of Welding Engineers, Ltd.: North-Western Branch.—At the College of Technology, Manchester. "Carbon Arc Welding," by Mr. A. Y. Stirrat. 7.30 p.m.

WEDNESDAY, NOVEMBER 11th.

Institution of Engineering Inspection.—In the Rooms of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Mechanical Testing of Materials," by Dr. G. H. Gulliver. 5.30 p.m.

THURSDAY, NOVEMBER 12th.

Borough Polytechnic.—Borough-road, S.E. 1. Annual Prize Distribution, by Professor C. E. Inglis. 7.30 p.m.

Faraday Society.—In the Rooms of the Chemical Society. Discussion on "The Oxidation of Fuel Vapours in Air." 8 p.m.

Institute of Metals.—At the Royal School of Mines, South Kensington, S.W. 7. "Some Recent Advances in Rolling Plant," by Dr. W. J. P. Rohn. 8 p.m.

Institute of Metals: Birmingham Local Section.—In the Chamber of Commerce, New-street, Birmingham. Open discussion, "Mechanical Testing," opened by Mr. W. A. Benton. 7 p.m.

FRIDAY, NOVEMBER 13th.

Chemical Engineering Group.—Burlington House, Piccadilly, W. 1. "Platinum," by Mr. Donald McDonald. No time stated.

Institute of Metals: Sheffield Local Section.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Engineering Silver Solders," by Mr. E. A. Smith. 7.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. Annual general meeting. 7.30 p.m.

MONDAY, NOVEMBER 16th.

National Institute of Industrial Psychology.—At the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Recent Research into the Causes of Industrial Accidents," by Mr. Eric Farmer. 6 p.m.

TUESDAY, NOVEMBER 17th.

Institution of Automobile Engineers.—Seagrave Club, Queen-street, Wolverhampton. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Special meeting. "The Pressure Cable—an Advance in the Construction of High-voltage Cable Installations," by Messrs. M. Hachstadter, W. Vogel and E. Bowden. 8 p.m.

WEDNESDAY, NOVEMBER 18th.

Institution of Automobile Engineers.—Metropole Hotel, King-street, Leeds. "The Training of Young Automobile Engineers," by Mr. B. G. Robbins. 7.15 p.m.

FRIDAY, NOVEMBER 20th.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, Westminster, S.W. 1. Sixth Report of the Marine Oil Engine Trials Committee, to be presented by Eng. Vice-Admiral Sir George G. Goodwin. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, S.W. 1. "Modern Pressed Brick Manufacture," by Mr. H. G. Brown. 7.30 p.m.